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Chapter 1: Introduction

This guide describes the operation of the ENCOM STRATOS Network Visualization and Management System. ENCOM STRATOS is a Microsoft Windows based application that is used to manage ENCOM broadband, point-to-point and mesh radios.

With ENCOM STRATOS, you can:

- Manage your ENCOM radios with a friendly user interface
- Remotely and configure your ENCOM radios
- View and optimize your wireless network performance
- Diagnose network and communication issues

This guide contains instructions, suggestions and information that will help you set up your radios and achieve optimal performance from your equipment.

ENCOM Radio Network Overview

ENCOM provides four distinct types of radios. These are:

- Standard broadband radios
- Point-to-point high-capacity radios
- Mesh radios
- Point-to-Multipoint radios

Although each type of radio is targeted at a particular application, they are flexible enough to be used in other roles if required. Click on the appropriate link for more information on a specific radio type.

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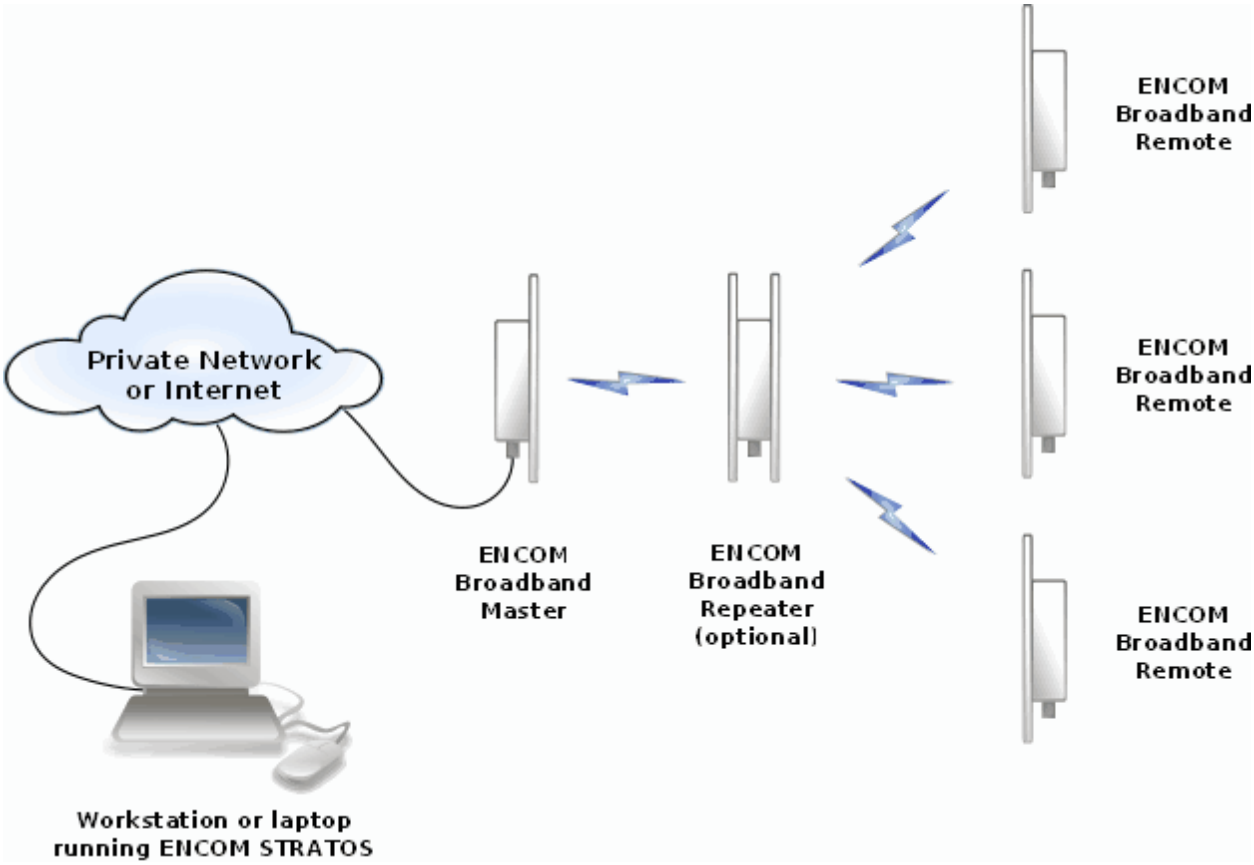
Broadband Radio Network

A broadband network consists of a single master radio that is connected to your private network, and one or more remote radios. The master radio handles the communication between the devices connected to the remote radios and the monitoring and control software installed in your network operations center. If the network has to span long distances, one or more repeaters are used to connect the master to the remote radios.

The following diagram shows a typical broadband radio network:



For information on configuring ENCOM broadband radios, refer to the following topic:

- Configuring Broadband Radios

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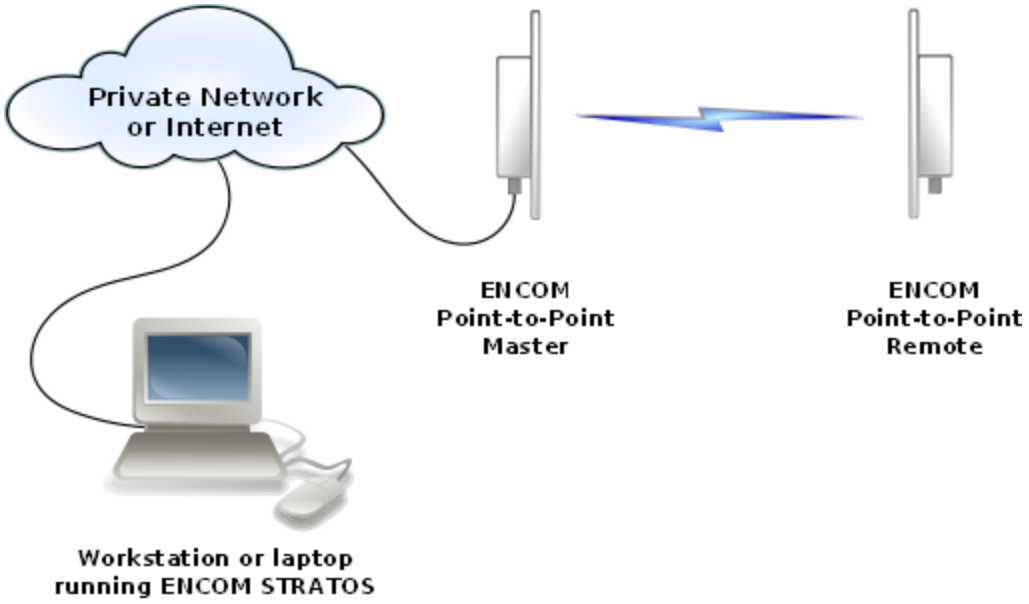
Point-to-Point Radio Network

A point-to-point network provides a long-distance, high-speed, backhaul for communications between the devices connected to the remote radios and the monitoring and control software installed in your network operations center.

The following diagram shows a typical broadband radio network:



For information on configuring ENCOM point-to-point radios, refer to the following topic:

- Configuring Point-to-Point Radios

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Mesh Radio Network

A mesh radio network consists of an arbitrary number of radios that can automatically manage their communication links. The main advantages of a mesh network, as opposed to the more traditional forms, are as follows:

- The network is self-forming (links are automatically formed between radios).
- The network is self-healing (if a radio fails, the remaining radios automatically reconfigure themselves to route packets around the failed radio).
- Routing algorithms in the radios automatically select the best path to use for routing packets.

ENCOM mesh radios provide a flexible solution for implementing mesh radios. In particular:

- You can specify whether the radios are used solely for meshing, for client access only, or both.
- Different antennas can be used based on the network design and communication requirements.
- The system can support multiple gateways (this provides redundancy for the wired link to your network operations center).
- Simplified configuration using the ENCOM STRATOS application.
- Secure communication using the latest WPA and WPA2 encryption technologies.

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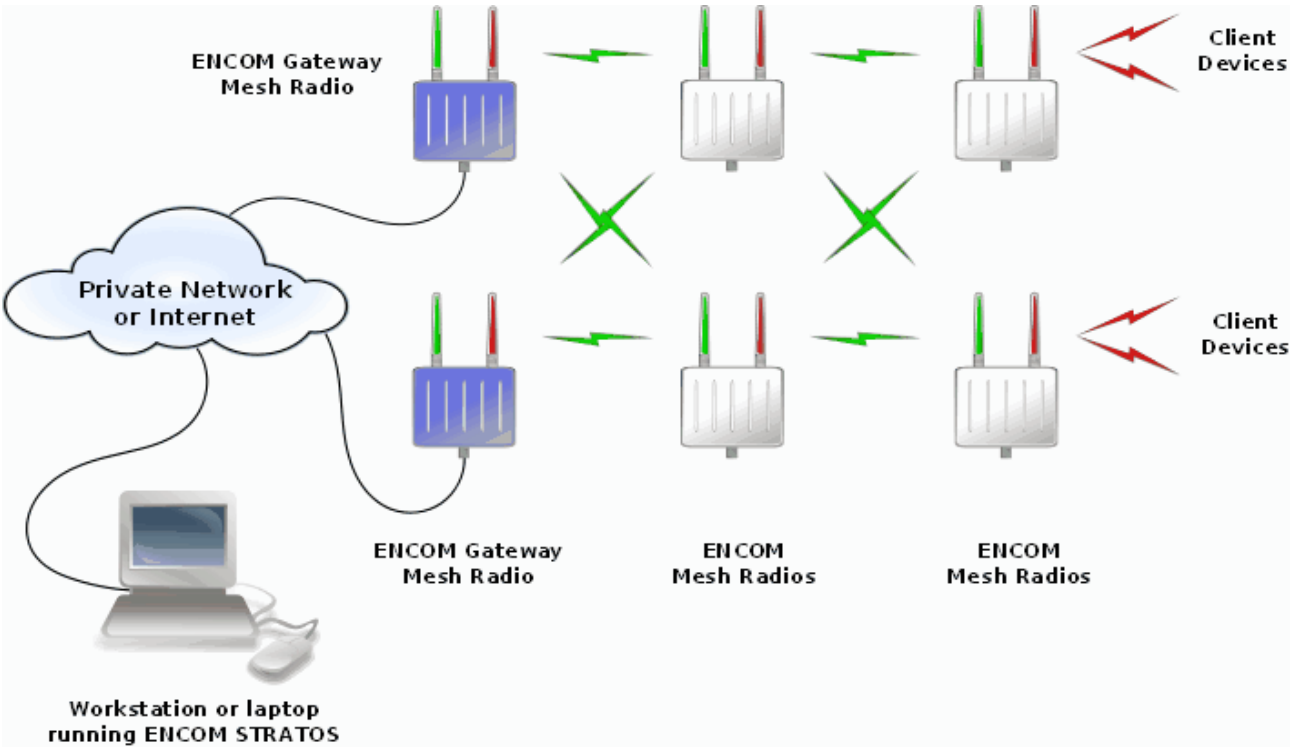
The following diagram shows a mesh radio network that is based on dual-radio nodes:



In this example:

- The first radio (shown in green) of each node is used for the mesh.
- The second radio (shown in red) of each node is used for local client access.
- Two radios (shown in blue) are wired to the private network to provide redundant access to the network.

Note: This example shows a simple mesh scenario. Other topologies, some that are simpler, and some that are more complicated, are supported.

For information on configuring ENCOM point-to-point radios, refer to the following topic:

- Configuring Mesh Radios

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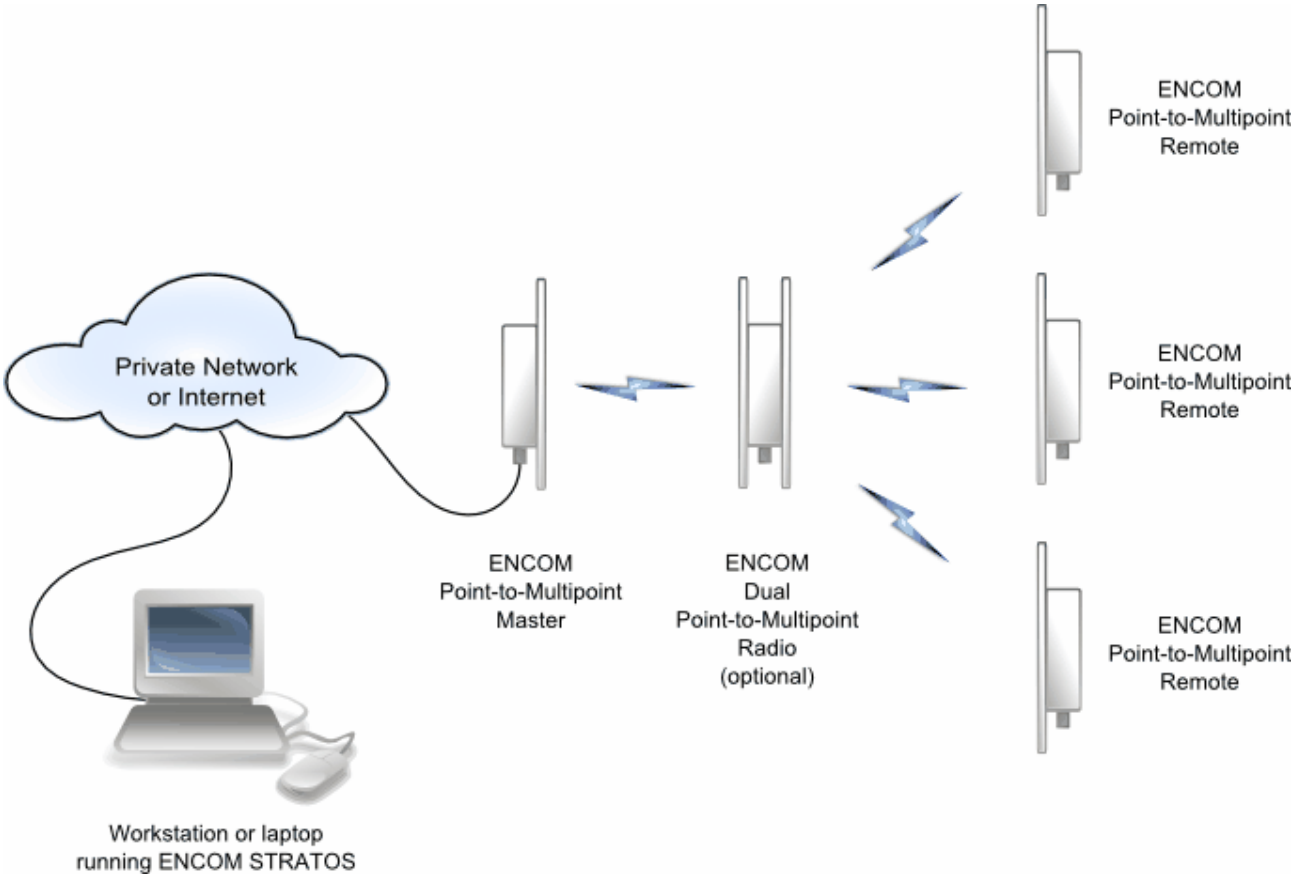
Point-to-Multipoint Radio Network

A point-to-multipoint network consists of a single master radio that is connected to your private network, and one or more remote radios. The master radio handles the communication between the devices connected to the remote radios and the monitoring and control software installed in your network operations center. The range of the network can be extended by using dual point-to-multipoint radios, or two single point-to-multipoint radios connected back-to-back via their Ethernet interfaces.

The following diagram shows a typical point-to-multipoint radio network:



For information on configuring ENCOM point-to-multipoint radios, refer to the following topic:

- Configuring Point-to-Multipoint Radios

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Chapter 2: Installation

System Requirements

ENCOM STRATOS was created to run on a wide variety of computers, from netbooks that can be used by field personnel to high-powered, multi-monitor workstations used in the network operations center.

In order to run ENCOM STRATOS, your computer must meet the following minimum requirements:

- Windows XP SP3, Vista, Windows 7 or Windows 8 operating system
- Microsoft .Net Framework 4.0 (full version, not the client profile)
- 1 GB RAM
- 1 GB free hard drive space
- Video card with a minimum 1024 x 600 resolution

Downloading STRATOS Software

ENCOM STRATOS is available for download from the ENCOM Wireless website. To download ENCOM STRATOS:

1. Go to the ENCOM STRATOS web page. It can be found at:
   - http://www.encomwireless.com/stratos
2. Click on the 'Download STRATOS' link.
3. Enter the appropriate information in the registration page, and press the **Send** button to request your copy of ENCOM STRATOS.
4. An email with a download link will be sent to the email address you specified in the registration page.

If you have trouble downloading or installing STRATOS, please contact ENCOM technical support, using any of the following options:

- Email: support@encomwireless.com
- Phone: 800-617-3487
403-230-1122
- Fax: 403-276-9575

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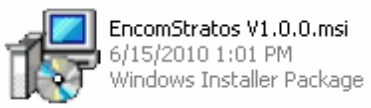
Installing STRATOS Software

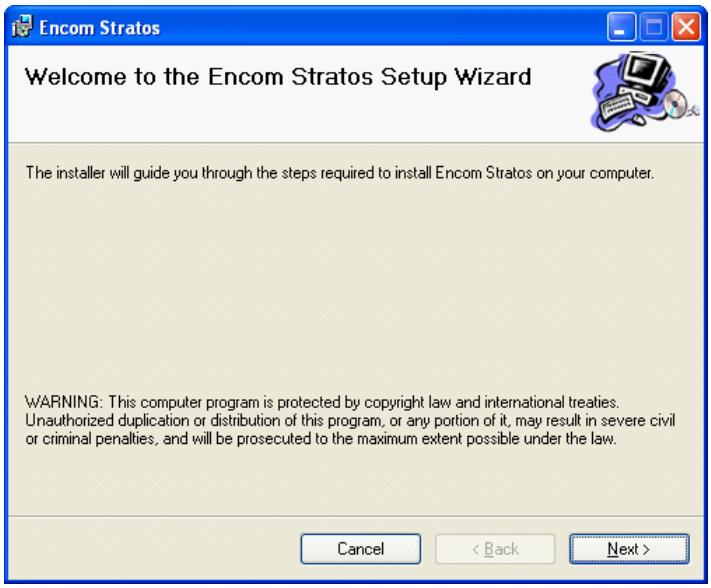
> **NOTE** Although ENCOM STRATOS will run under a standard user account, you will need administrator privileges to install the application. Please contact your IT department if you are unable to install STRATOS due to account restrictions.

After downloading STRATOS from the ENCOM website:

1. Double click the **EncomStratos Vx.x.x.msi** file to start the installation process (where x.x.x is the STRATOS version number).



2. The **ENCOM STRATOS Setup Wizard** will appear and will guide you through the installation of the application to your computer


Encom Stratos
Welcome to the Encom Stratos Setup Wizard
The installer will guide you through the steps required to install Encom Stratos on your computer.
WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extent possible under the law.
Cancel
< Back
Next >

Press the **Next** button to proceed.

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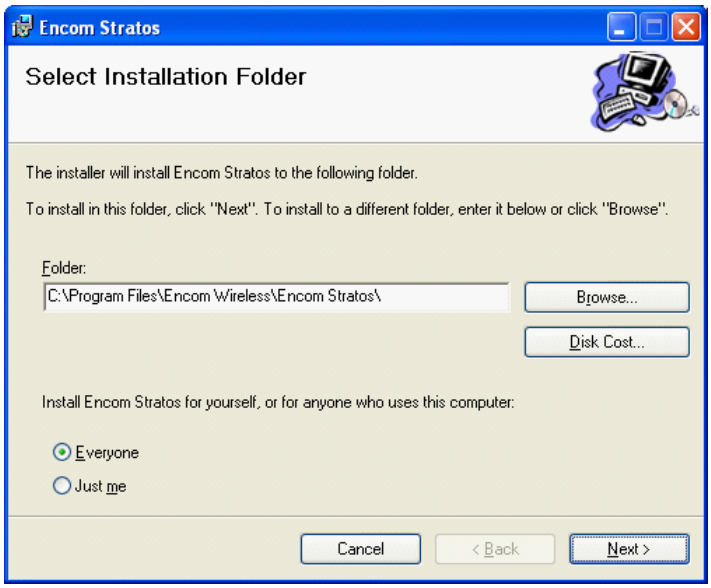
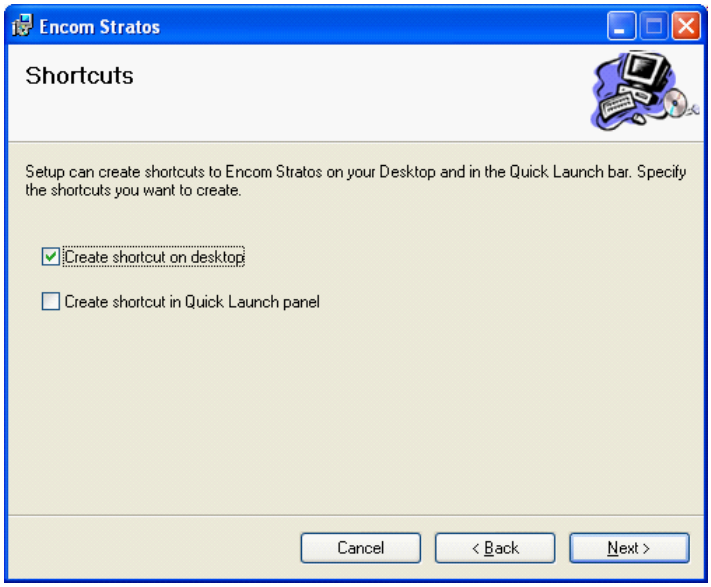
3. Select the folder on your computer where you would like ENCOM STRATOS to be installed.

   You can also instruct the setup wizard to install STRATOS for all users or the currently logged in user. Note that in both cases, you still need to have administrator privileges in order to successfully install the application.


Encom Stratos
Select Installation Folder
The installer will install Encom Stratos to the following folder.
To install in this folder, click "Next". To install to a different folder, enter it below or click "Browse".
Folder:
C:\Program Files\Encom Wireless\Encom Stratos\
Browse...
Disk Cost...
Install Encom Stratos for yourself, or for anyone who uses this computer:
Everyone
Just me
Cancel
< Back
Next >

   Press the **Next** button to proceed.

4. Check the desired shortcut options. Note that a shortcut will always be created under **Programs -> Encom -> Stratos** in the Windows **Start** menu.


Encom Stratos
Shortcuts
Setup can create shortcuts to Encom Stratos on your Desktop and in the Quick Launch bar. Specify the shortcuts you want to create.
Create shortcut on desktop
Create shortcut in Quick Launch panel
Cancel
< Back
Next >

   Press the **Next** button to proceed.

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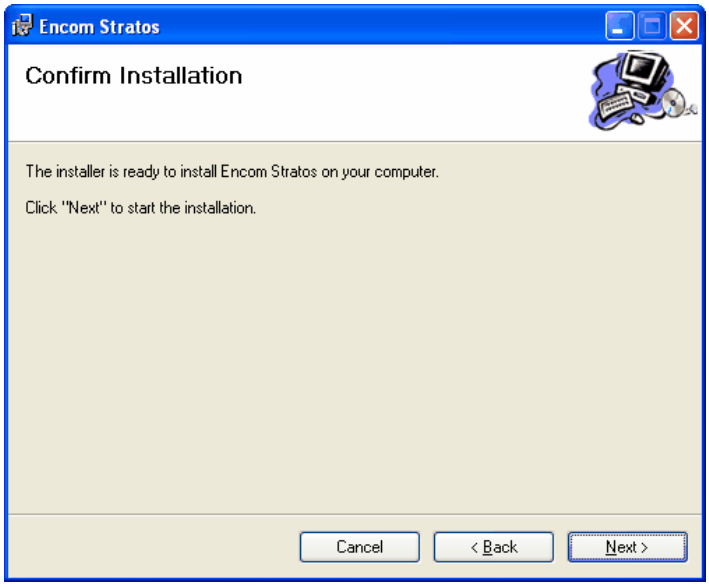
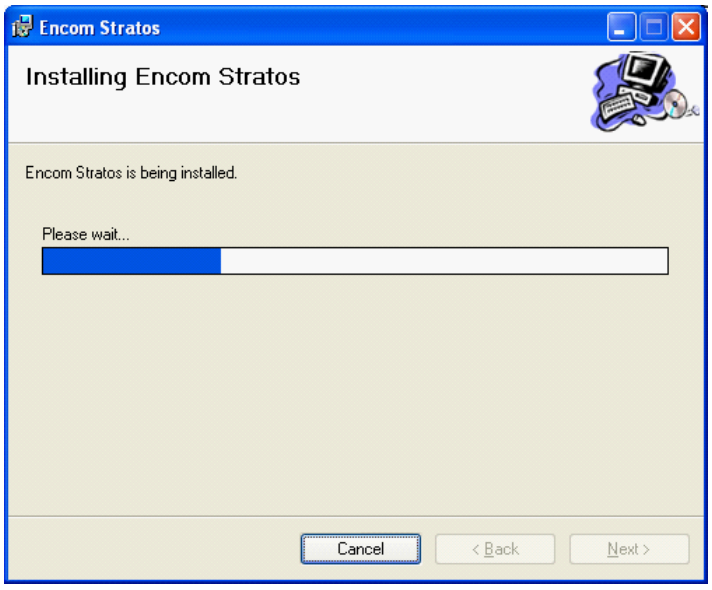
5. The final confirmation page is shown.


Encom Stratos
Confirm Installation
The installer is ready to install Encom Stratos on your computer.
Click "Next" to start the installation.
Cancel
< Back
Next >

Press the **Next** button to proceed.

6. ENCOM STRATOS will be installed on your computer.



Enter the appropriate administrator account credentials if you are prompted to do so.

7. When the installation has completed, press the **Close** button to exit the installation wizard.
8. ENCOM STRATOS is now installed on your computer.

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Network Setup

ENCOM STRATOS makes use of certain network services to carry out its configuration and management tasks. Because of this, you must configure your network's firewalls and routers to allow access to these services.

In particular, the following ports must be opened between the radios and the computer on which ENCOM STRATOS is running:

Service	Protocol	Port
ICMP (Ping)	Not Applicable	Not Applicable
FTP	TCP	20, 21
SSH	TCP	22
ENCOM Mesh Interface	UDP	1966
ENCOM Mesh Interface	TCP	1968
ENCOM Radio Heartbeat	UDP	5678
ENCOM Radio Interface	TCP	8291
ENCOM Radio Interface	TCP	8728
ENCOM Radio Interface	UDP	20561

NOTE

ENCOM Radio Heartbeat packets are broadcast packets. Because of this, they are not able to pass through routers or firewalls.

This means that the STRATOS automatic radio discovery feature may not work if a router or firewall is present between the computer running STRATOS and the radios. In this case, you need to use the Add or Find radio functions to manually add the radios to the radio list.

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Chapter 3: Connecting to a Radio

In order to communicate with a radio, ENCOM STRATOS needs either:

- A direct connection to the radio's ethernet port.
- A direct connection to the ethernet port of a master or gateway radio that has a wireless connection to the radio you want to connect to.

The following topics describe how to set up a direct connection to the radio:

- Powering the Radio
- Connecting Directly to Your Computer
- Connecting Using a Switch or Router

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Powering the Radio

ENCOM radios are powered by a Power-over-Ethernet (PoE) Injector. Power-over-Ethernet technology provides the ethernet communications and the radio power over a single, standard Ethernet cable. A typical PoE injector is shown below::

PoE Injectors typically contain 3 sockets:

- A standard power cable socket.
- An RJ-45 style Ethernet socket.
- An RJ-45 style PoE socket.

Connect one end of the power cable into the PoE injector and the other into a 120 VAC power source. An LED will illuminate when the PoE injector receives power.

If you are connecting the radio directly to your computer, use an Ethernet crossover cable to connect your computer to the Ethernet socket on the PoE injector. If you are connecting the radio to your network, use a standard Ethernet cable to connect your network router or switch to the Ethernet socket on the PoE Injector.

Finally, use a standard Ethernet cable to connect the radio's Ethernet port to the PoE socket on the PoE Injector.

The PoE socket is normally (but not always) marked with a warning label.

Never plug a network cable that connects directly to your network or computer into the PoE socket. Doing this could damage your computer or network device.

When installing a radio in the field, the PoE Injector must be installed inside of a cabinet or building to protect it from the weather.

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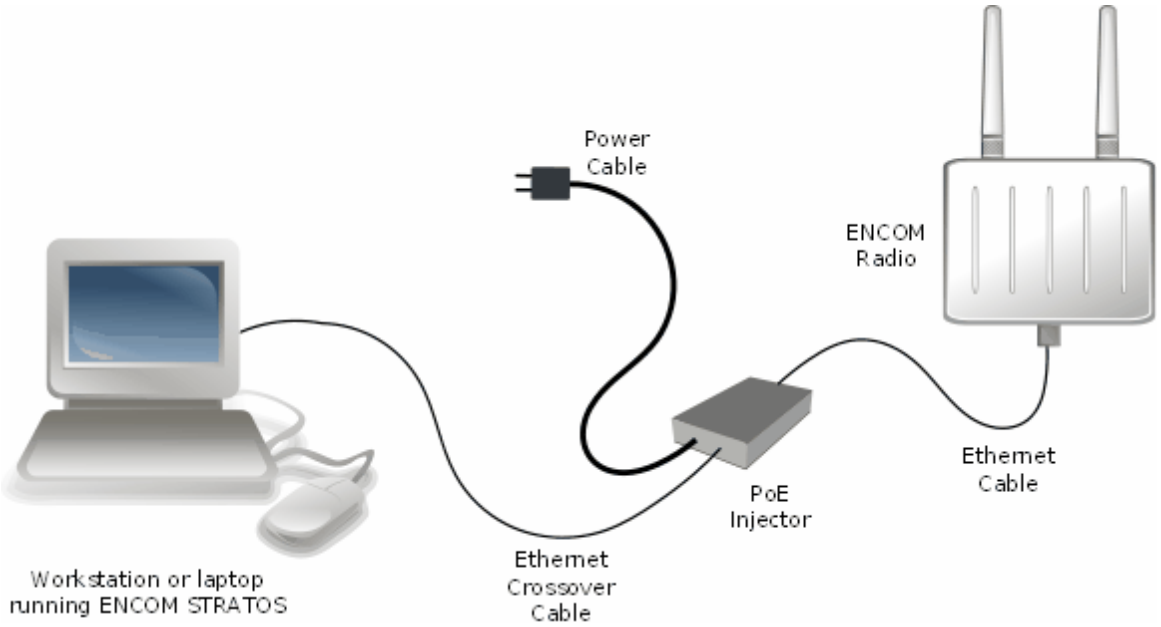
Connecting Directly to Your Computer

When provisioning a new radio, or working on a radio in the field, you will need to connect the radio directly to your computer.

The following diagram shows a typical direct connection to the radio:



In this scenario, the computer is connected to the Ethernet port of a Power-over-Ethernet (PoE) injector using an Ethernet crossover cable.

A standard Ethernet cable is used to connect the radio to the PoE injector.

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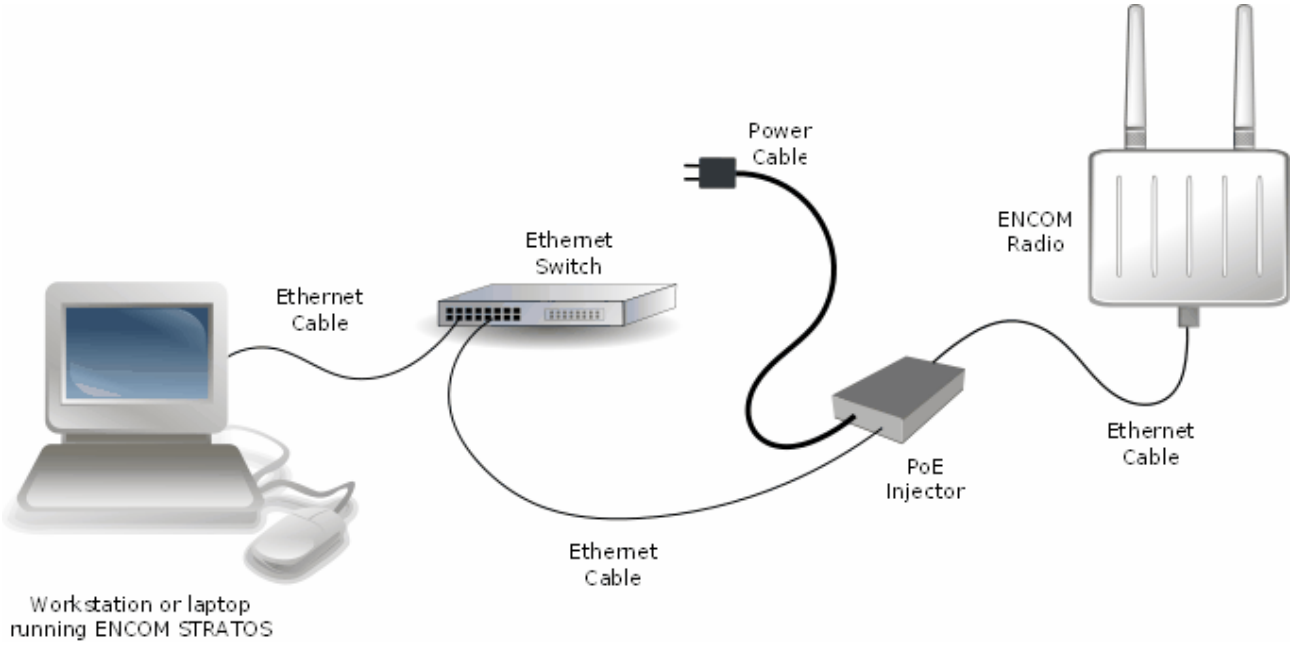
Connecting Using a Switch or Router

If you have access to an Ethernet switch, you can set up the connection to the radio using the switch. This removes the need for an Ethernet crossover cable.

The same type of connection is also used if the radio has been deployed and is already connected to your network infrastructure.

The following diagram shows a typical connection using a switch (a router could also be used):



In this scenario, the computer and the PoE injector are connected to the switch using standard Ethernet cables.

A standard Ethernet cable is used to connect the radio to the PoE injector.

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Chapter 4: Using ENCOM STRATOS

Running ENCOM STRATOS

You can run ENCOM STRATOS using any of the following methods

- Select **Programs -> Encom -> Stratos -> Stratos** from the Windows **Start** menu
- If you requested that a STRATOS shortcut be installed on your desktop, you can start STRATOS by double-clicking the desktop icon:

If you requested that a STRATOS shortcut be installed in the QuickLaunch panel, you can start STRATOS by clicking on the QuickLaunch icon:

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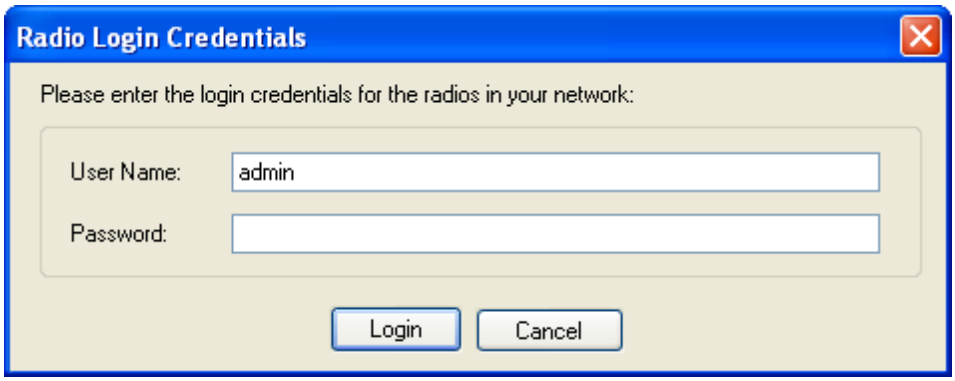
Radio Login Form

When you run ENCOM STRATOS, you will be presented with the *Radio Login Credentials* form:



Enter the user name and password used to login to your radios. This information will be used by STRATOS whenever it needs to access the radios. If the user names or passwords differ from radio to radio, you will be prompted to enter the individual radio's login credentials when required.

By default, the **User Name** is *admin* and the **Password** field is left blank.

Press the **Login** button to accept the login credentials and log into STRATOS.

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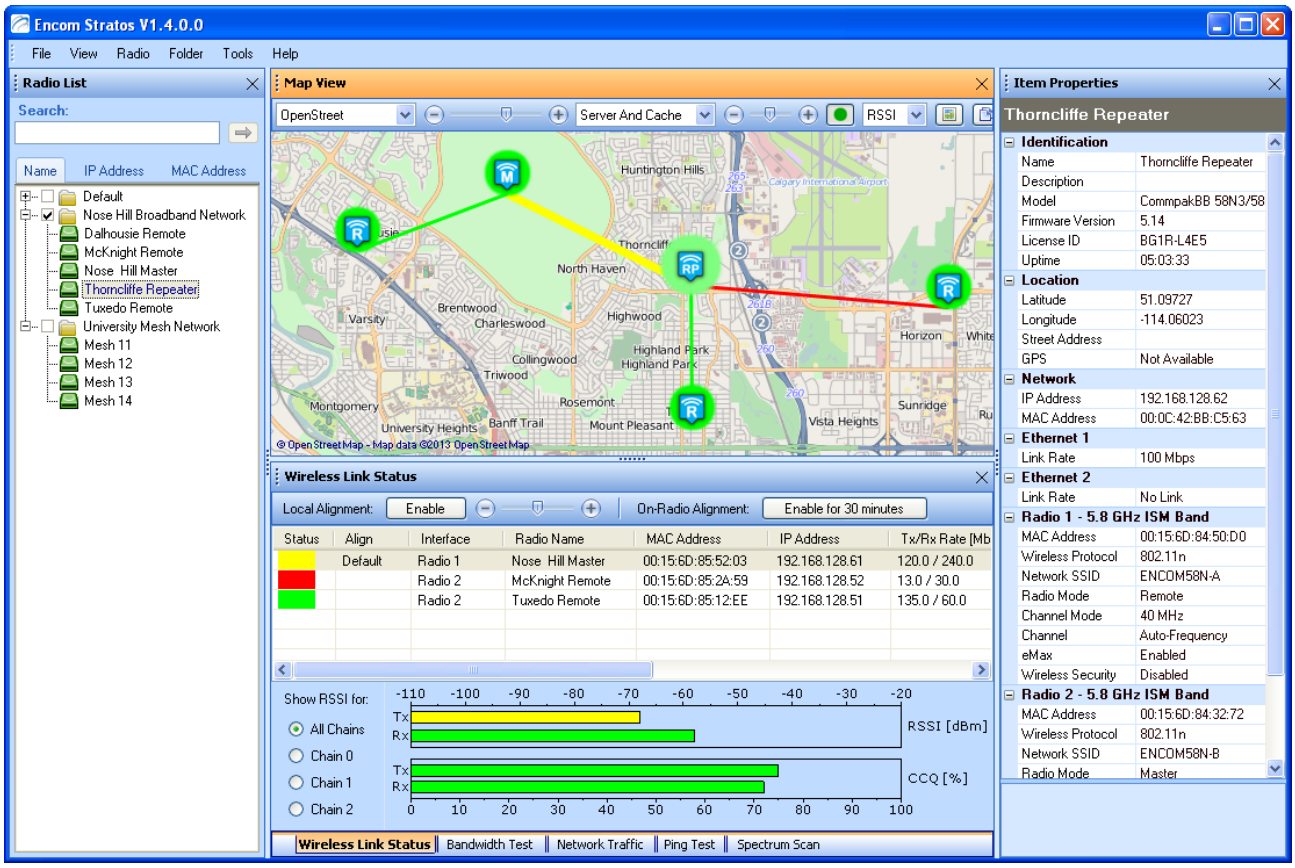
User Interface

The following screen shot shows the main window of a typical ENCOM STRATOS session:



The main features of the STRATOS user interface include:

- A Menu Bar at the top of the window that allows you to access most of the application's features.
- A Radio List panel that contains the list of ENCOM radios available in your network.
- A Map View panel that shows the physical locations of your radios on a map.
- An Item Properties panel that displays important information on the folder or radio that is currently selected in the radio list.
- A Wireless Link Status panel that displays the state of the Wireless links of the radio that is currently selected in the radio list.
- A Bandwidth Test panel that allows you to carry out performance tests against the radio that is currently selected in the radio list.
- A Network Traffic panel that allows you to visualize the traffic on the wired and wireless links of the radio that is currently selected in the radio list.
- A Ping Test panel that allows you to perform ping latency tests on selected radios.
- A Spectrum Scan panel that shows a profile of the wireless activity within the vicinity of the radio that is currently selected in the radio list.

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- A Task List panel that displays the status of long running tasks.
- An Alerts panel that displays the various alarm messages that can be generated by STRATOS.
- A Terminal panel that allows you to interact with the radio that is currently selected using a text-based terminal interface.

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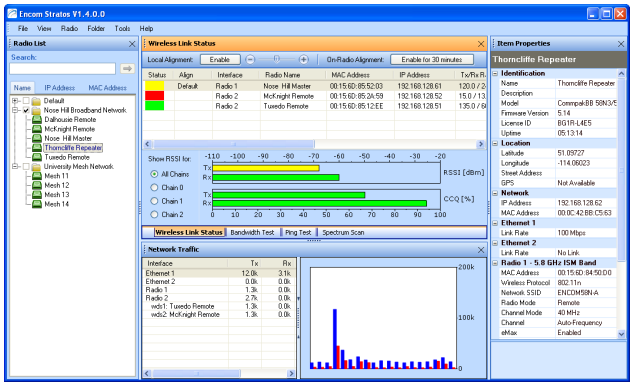
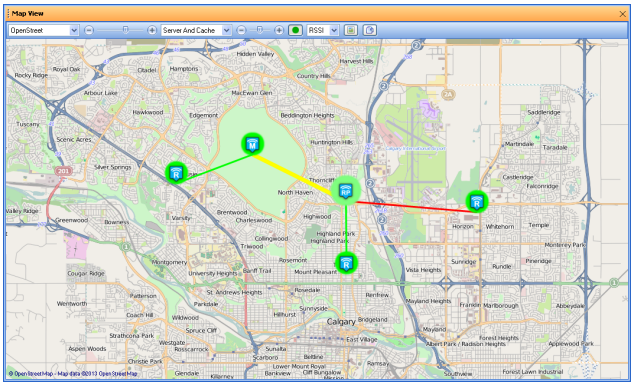
Customizing the User Interface

The ENCOM STRATOS user interface consists of panels that can be resized and repositioned independently. This gives you the maximum flexibility to arrange the user interface to suit your needs. The size and location of each panel is saved when the application is shut down and automatically restored when you run the application again.

A common scenario is to run ENCOM STRATOS on a dual display workstation. The Map View panel can be detached from the main window and expanded to fit the second display. The remaining panels are left in the main window, but are arranged to make maximum use of the display. The following screen shots show an example of this arrangement:



STRATOS main window on first monitor



STRATOS Map View on second monitor

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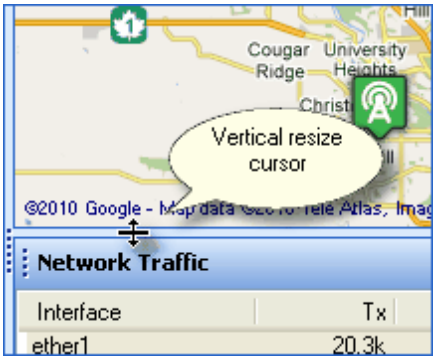
Resizing a Panel

To resize a panel:

1. Position the mouse pointer in the space between two panels. Depending on the location of the two panels, the mouse pointer will turn into a vertical or horizontal resize cursor.



2. Click and hold down the mouse button, and then drag the mouse in the desired direction.
3. The panel on either side of the mouse pointer will be resized accordingly.

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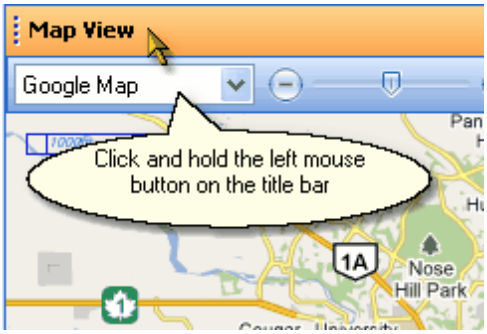
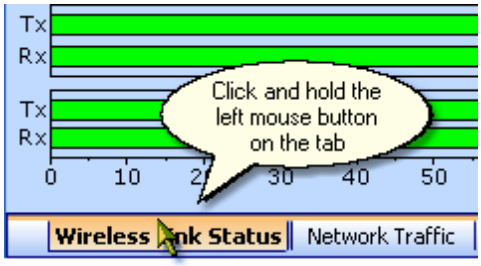
Repositioning a Panel

To reposition a panel:

1. Select the panel by clicking and holding down the left mouse button on the panel's title bar.



If the panel is currently part of a tabbed group, click and hold the left mouse button on the panel's tab.



2. Drag the panel with the mouse. This action will detach the window's panel from its current location and allow you to select a new location for the panel. When you have moved the panel to its desired location, release the mouse button.

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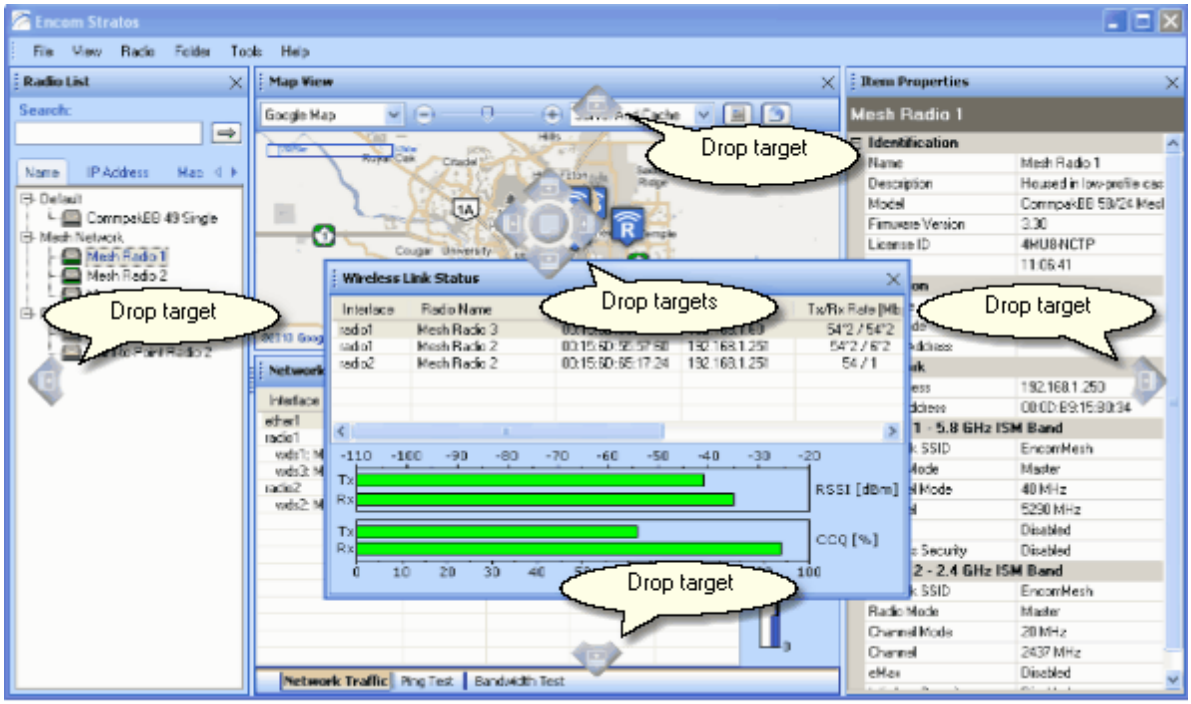
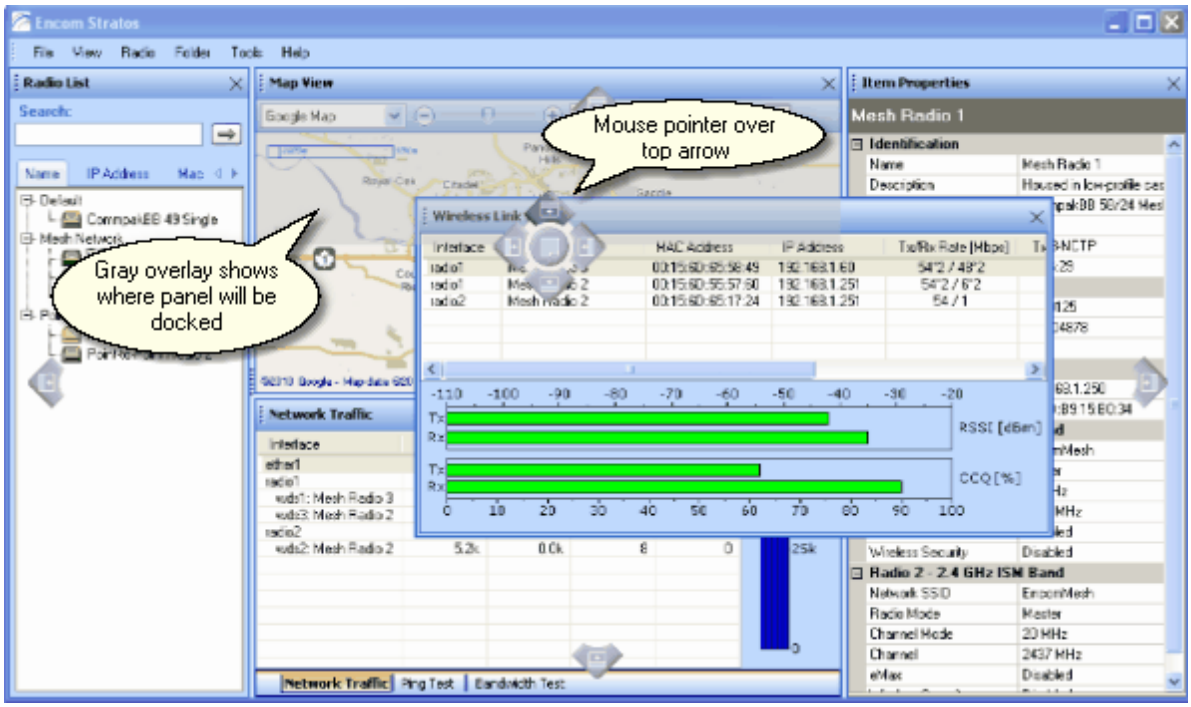
3. While you are dragging the panel, drop targets are displayed in the STRATOS main window.



4. If you move the mouse pointer over a drop target, a gray overlay is displayed that shows the new position of the panel.



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5. The drop targets close to the edges of the STRATOS main window (shown below) will cause the panel to be docked at the edge of the main window.

6. The drop targets that are clustered together (shown below) will cause the panel to be docked inside of the panel on which the mouse window is hovering.

7. If you release the mouse button when the mouse pointer is not hovering over a drop target, the panel will be left floating. You can move a floating panel to any location inside or outside of the main window.

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Menu Bar

The main menu bar provides access to most of the ENCOM STRATOS functions. Many of these functions can also be accessed by context sensitive menus that are available in the various user interface panels.

File Menu Commands

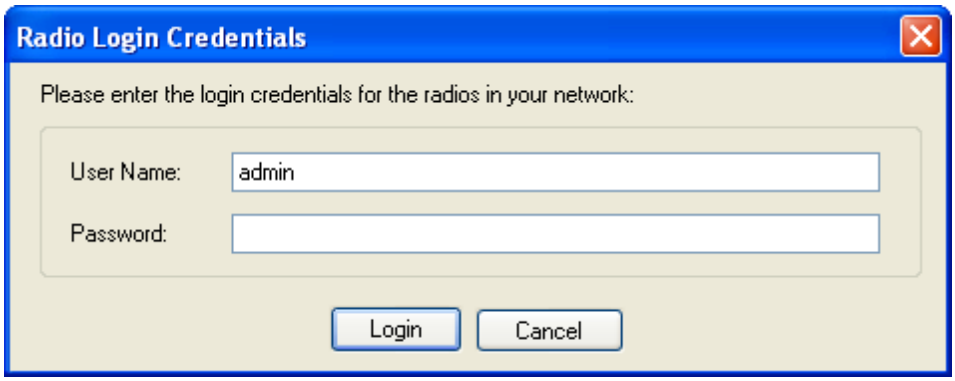
Change Login Credentials...

When you run ENCOM STRATOS, you are prompted for the radios' login credentials. The credentials are used by STRATOS whenever it needs to access the radios.

If you entered the wrong information, STRATOS will not be able to log into the radios, and will prompt you for the credentials when required. To address this situation, you can either:

- Close down STRATOS and run it again, entering the correct credentials when prompted.
- Select the **Change Login Credentials...** item from the **File** menu and enter the correct credentials at the prompt. This option is useful if you don't want to shut down the application.

When you select the **Change Login Credentials...** menu item, the *Radio Login Credentials* form is shown:



Enter the appropriate login credentials, and then click the **Login** button to accept them. STRATOS will now use the new credentials when it tries to login to the radios.

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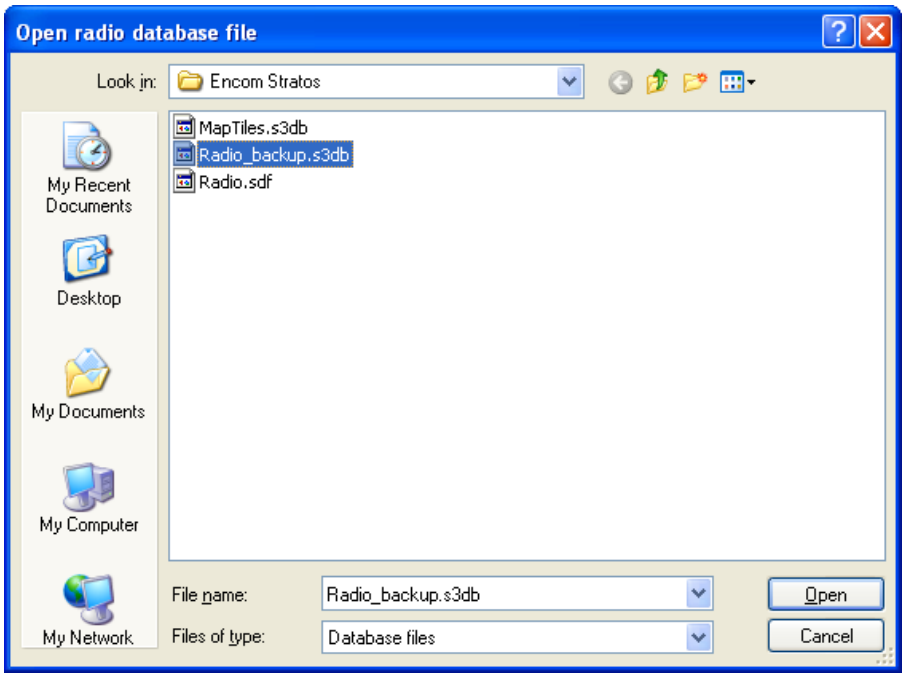
Import -> Radio List

Select **Import -> Radio List** from the **File** menu to replace the contents of the radio list panel with the contents of a previously saved radio list database file. (Use the Export Radio List function to create such a database file.)

This function is useful in cases where you want to restore the radio list from a backup copy or transfer radio information from one workstation to another.

To import a radio list database:

1. Select **Import -> Radio List** from the **File** menu. You will be prompted to open a radio database file:



2. Select the file that contains the radio list you want to import, and then press the **Open** button.

3. STRATOS will check the file you selected to ensure that it contains a valid radio list database. If the file is not valid, the following prompt is displayed:

Could not import!
The file you selected is not a radio database file.
Please select a valid radio database file, and try again.
OK

4. If you selected a valid radio list database file, the contents of the radio list panel will be replaced with the contents of the selected database file.

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NOTE

Starting with ENCOM STRATOS V1.3.0, radio list databases are identified with the **.sdf** file extension. Previous versions of STRATOS used the **.s3db** file extension.

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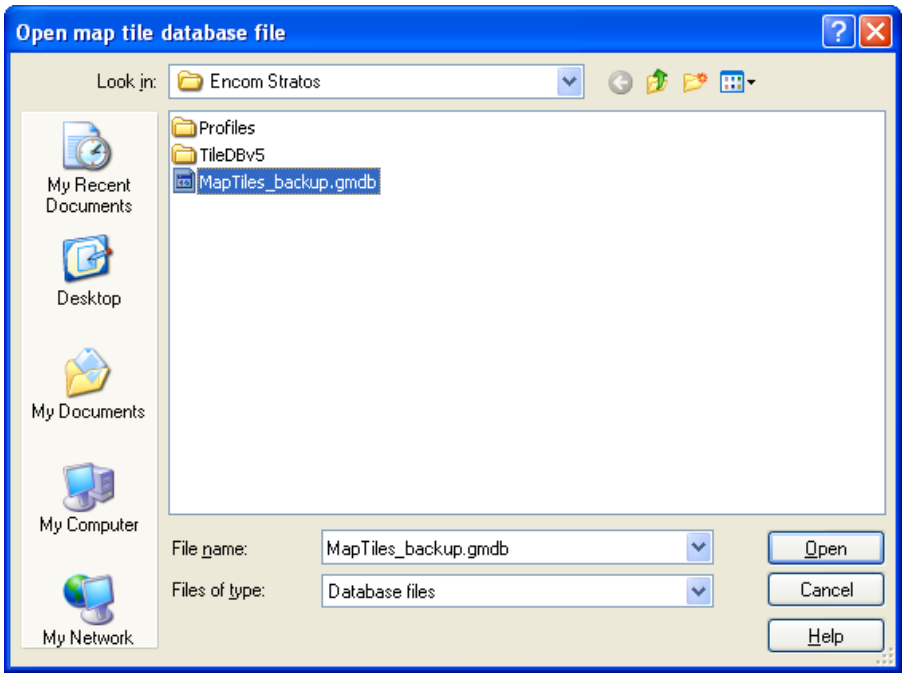
Import -> Map Tiles

Select **Import -> Map Tiles** from the **File** menu to add the contents of a previously saved map tile database to the local map tile cache. (Use the Export Map Tiles function to create such a database file.)

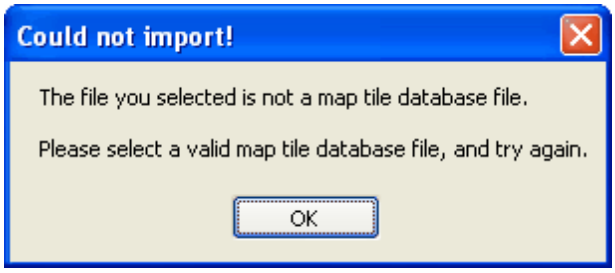
This function is useful in cases where you want to use STRATOS on a computer that does not have Internet access. Simply export the map tiles from a workstation that has access to on-line maps, and import them into the computer that does not have Internet access. That way, you will have access to those sections of the map that have been cached.

To import a map tile database:

1. Select **Import -> Map Tiles** from the **File** menu. You will be prompted to open a map tile database file:



2. Select the file that contains the map tiles you want to import, and then press the **Open** button.
3. STRATOS will check the file you selected to ensure that it contains a valid map tile database. If the file is not valid, the following prompt is displayed:


Could not import!
The file you selected is not a map tile database file.
Please select a valid map tile database file, and try again.
OK

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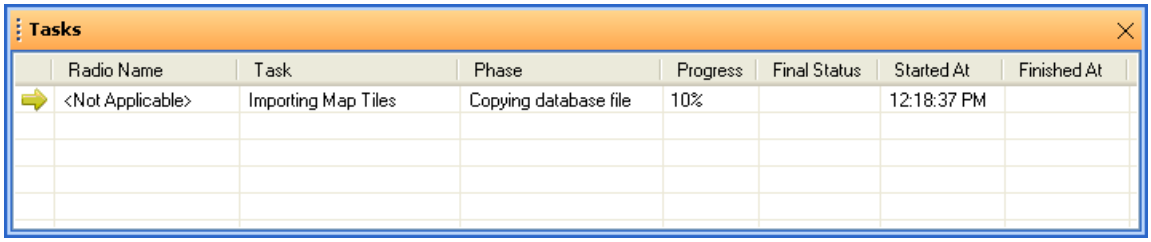
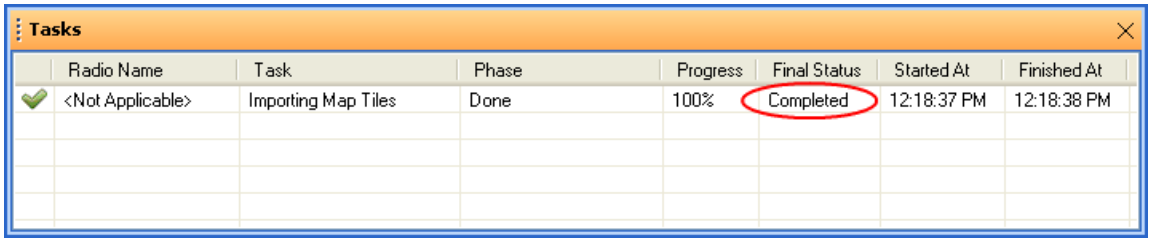
4. If you selected a valid map tile database file, the Task List panel will be activated and shown if it was hidden.
5. A new task will be added to the task list. It will show the progress of the import function:



6. If the import is successful, the computer's map tile database will have been updated. The task item will indicate that the map tiles have been successfully imported:



NOTE

Starting with ENCOM STRATOS V1.4.0, map tile databases are identified with the **.gmdb** file extension. Previous versions of STRATOS used the **.s3db** file extension. The **.s3db** map tile databases are no longer compatible with ENCOM STRATOS, and attempts to import these files will fail.

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Export -> Radio List

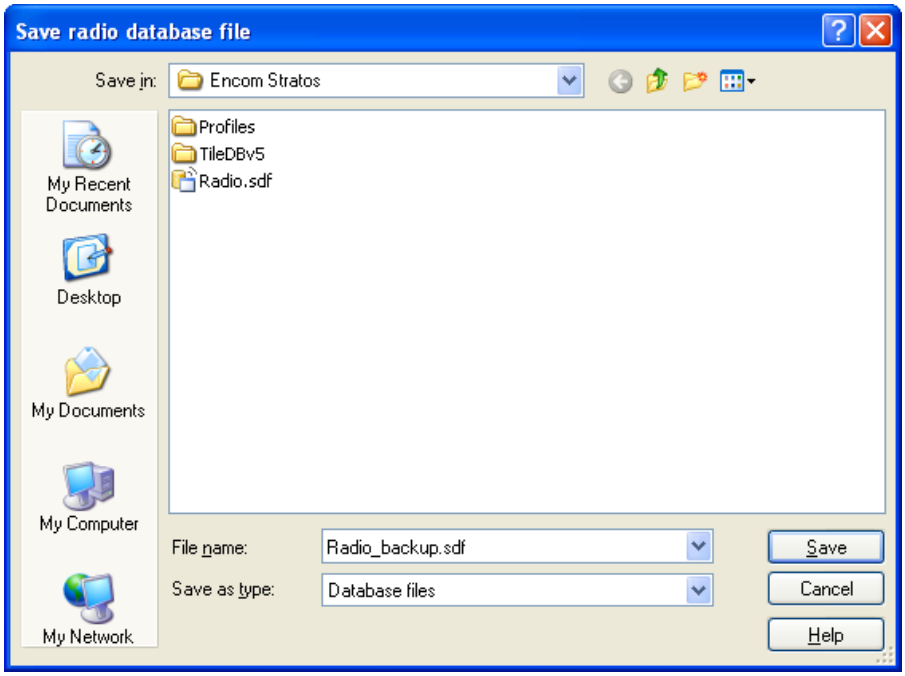
Select **Export -> Radio List** from the **File** menu to save the current radio information to a database file. The following information is saved:

- The radios displayed in the radio list panel.
- The folder structure of the radio list panel.
- Last known configuration settings of all radios displayed in the radio list panel.

This function is useful for making backups of the current radio network state. Use the Import Radio List function to restore the radio information from a saved database file.

To export the radio information:

1. Select **Export -> Radio List** from the **File** menu. You will be prompted to save the radio database file:



2. Enter the name of the export file in the **File name** field, and then press the **Save** button.

NOTE Starting with ENCOM STRATOS V1.3.0, radio list databases are identified with the **.sdf** file extension. Previous versions of STRATOS used the **.s3db** file extension.

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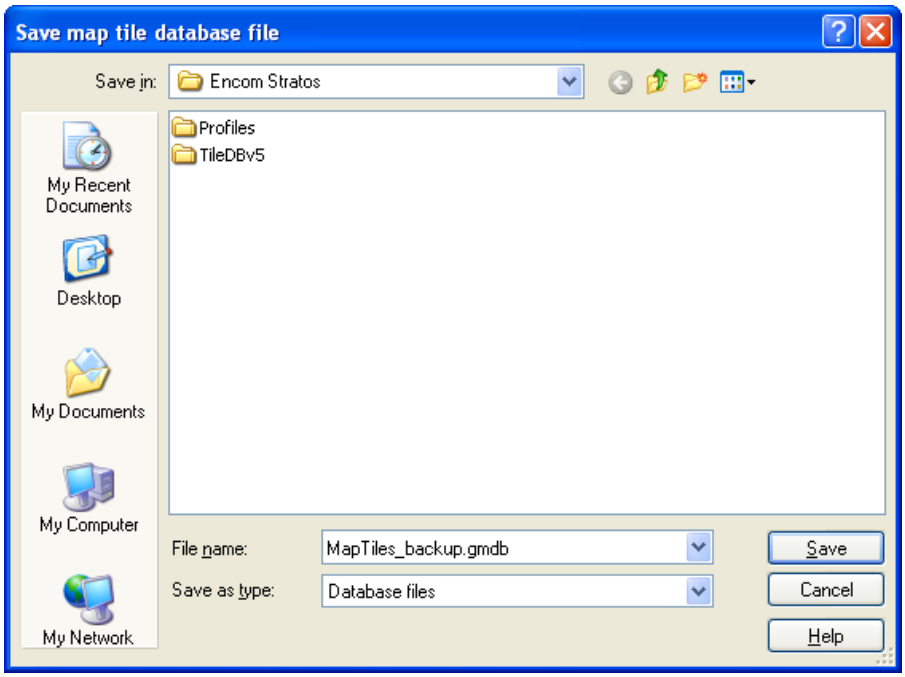
Export -> Map Tiles

Select **Export -> Map Tiles** from the **File** menu to save the currently cached map tiles to a database file.

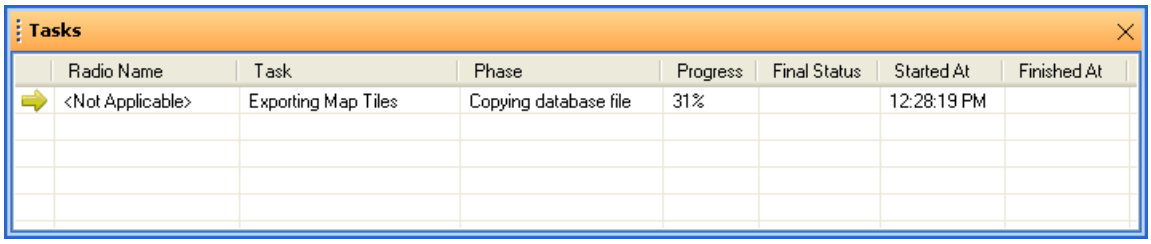
This function is useful in cases where you want to use STRATOS on a computer that does not have Internet access. Simply export the map tiles from a workstation that has access to on-line maps, and import them into the computer that does not have Internet access. That way, you will have access to those sections of the map that have been cached. Use the Import Radio List function to load the map tiles from a saved database file.

To export the cached map tiles:

1. Select **Export -> Map Tiles** from the **File** menu. You will be prompted to save the radio database file:



2. Enter the name of the export file in the **File name** field, and then press the **Save** button.
3. The Task List panel will be activated and shown if it was hidden.
4. A new task will be added to the task list. It will show the progress of the export function:



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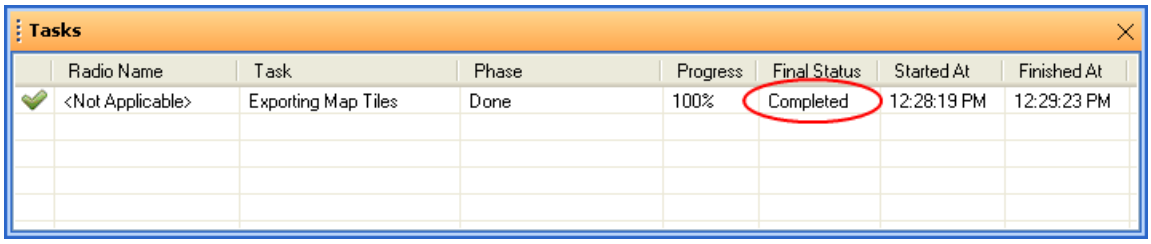
5. If the export is successful, the task item will indicate that the map tile database has been successfully saved:



NOTE

Starting with ENCOM STRATOS V1.4.0, map tile databases are identified with the **.gmdb** file extension. Previous versions of STRATOS used the **.s3db** file extension. The **.s3db** map tile databases are no longer compatible with ENCOM STRATOS, and attempts to import these files will fail.

Exit

Select **Exit** from the **File** menu to shut down ENCOM STRATOS.

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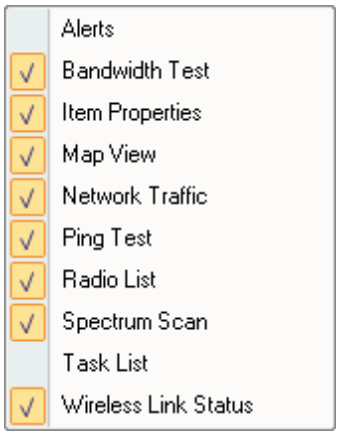
View Menu Commands

Panels

Selecting **Panels** from the **View** menu displays the list of available user interface panels.



Selecting an item that is checked will hide the associated panel. Conversely, selecting an item that is not checked will show the associated panel.

The Alerts panel is normally hidden. It is automatically displayed when an alert is generated by STRATOS. See the System Settings form's Alerts topic for a list of alerts that can be generated by STRATOS.

The Task List panel is normally hidden. It is automatically displayed when you use a function that triggers a long running task (such as the Restore to Factory Default or Upgrade Firmware functions). These tasks run in the background, and display their progress in the task list.

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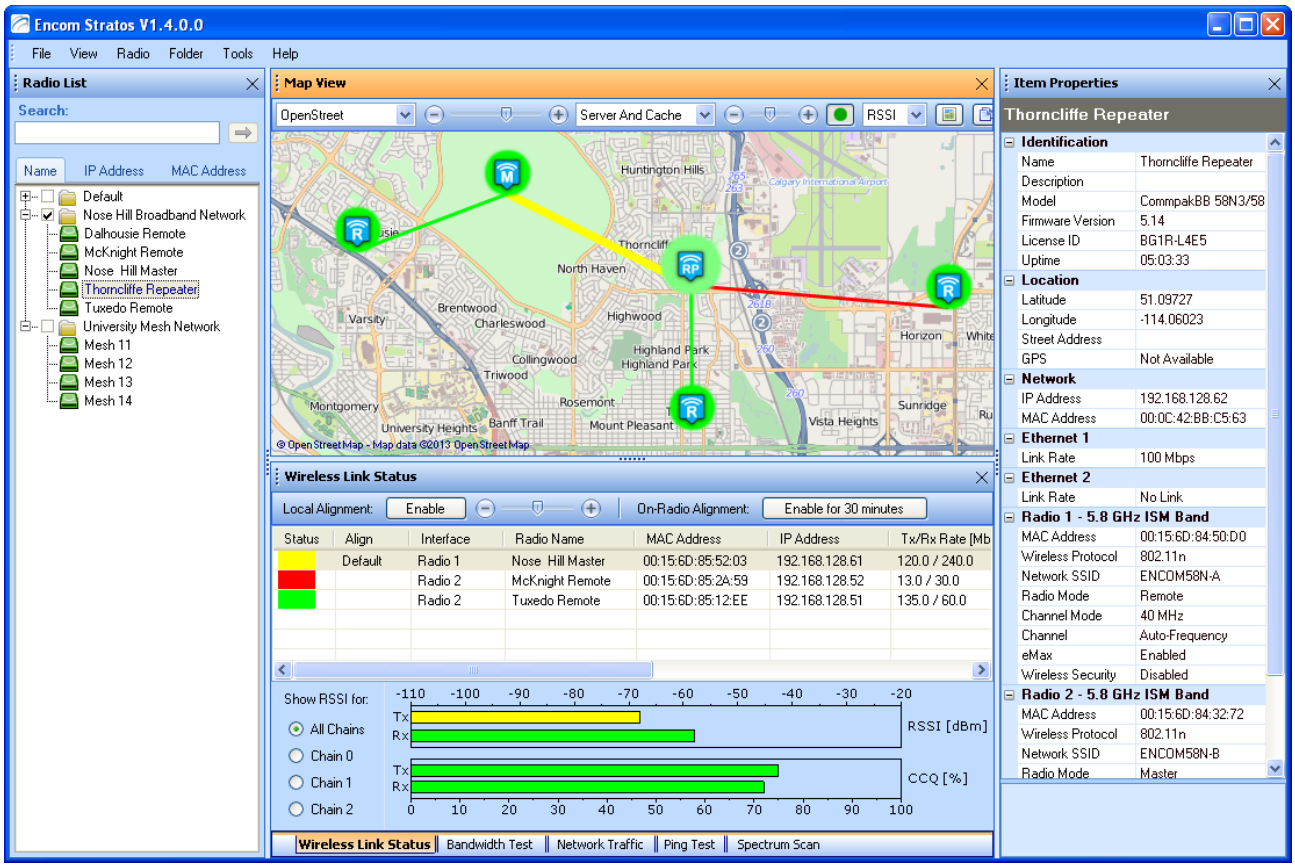
Restore Original Layout

Select **Restore Original Layout** from the **View** menu to reset the user interface panels to their original locations and sizes.

This function is useful if you have moved and hidden panels, and you no longer find the layout useable. All but the task panel will be made visible. The panels will be laid out as follows:



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Radio Menu Commands

Configure

Select **Configure** from the **Radio** menu to display the radio's configuration form.

If the radio is currently on-line, STRATOS will:

- Log into the radio
- Get the radio's current configuration
- Display the radio's current configuration in the radio configuration form

If the radio is not currently on-line, STRATOS will:

- Inform you that the radio is off-line
- Prompt you to view the radio's last know configuration
- Display the radio's last known configuration in the radio configuration form (you will not be able to make changes to the settings)

The broadband, mesh, point-to-point and point-to-multipoint radios have very different configuration settings. Because of this, a separate configuration section is provided for each radio type. Refer to the appropriate section for more information:

- Configuring Broadband Radios
- Configuring Point-to-Point Radios
- Configuring Mesh Radios
- Configuring Point-to-Multipoint Radios

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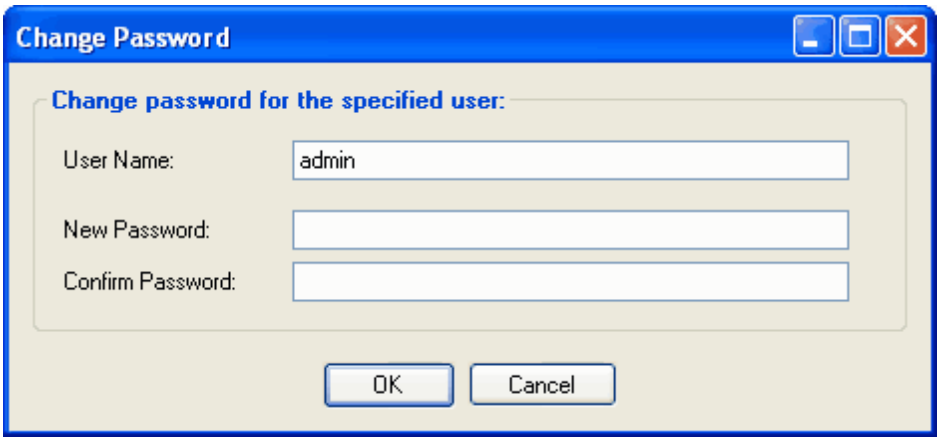
Change Password

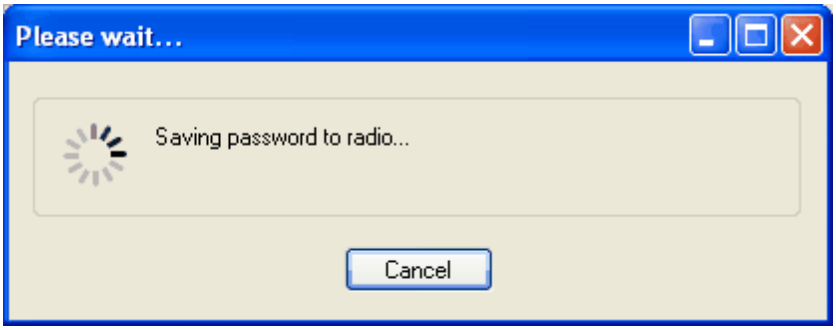
Select **Change Password** from the **Radio** menu to change the radio's current login password.

When then **Change Password** menu item is selected, the *Change Password* form is displayed:



Enter the new password in the **New Password** and **Confirm Password** fields, and press **OK** to proceed.

A wait form will be displayed while the radio's login password is changed:



After the password has been successfully changed, the *Change Password* form is automatically closed.

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Add to Ping Test

Select **Add to Ping Test** from the **Radio** menu to add the selected radios to a ping test session.

A ping test consists of periodically sending ICMP messages (pings) to a group of radios and recording the latency of the responses. It is used for getting a qualitative analysis of your network's performance.

To carry out a ping test:

1. Select one or more radios, or one of more folders, in the Radio List panel. For information on selecting multiple radios or folders, refer to the Selecting Radios topic.
2. Select **Add to Ping Test** from the **Radio** menu.
3. The Ping Test panel will be activated and shown if it was hidden.
4. The ping test will automatically start, using the radios that you have selected.

For more information regarding the ping test, refer to the Ping Test panel topic.

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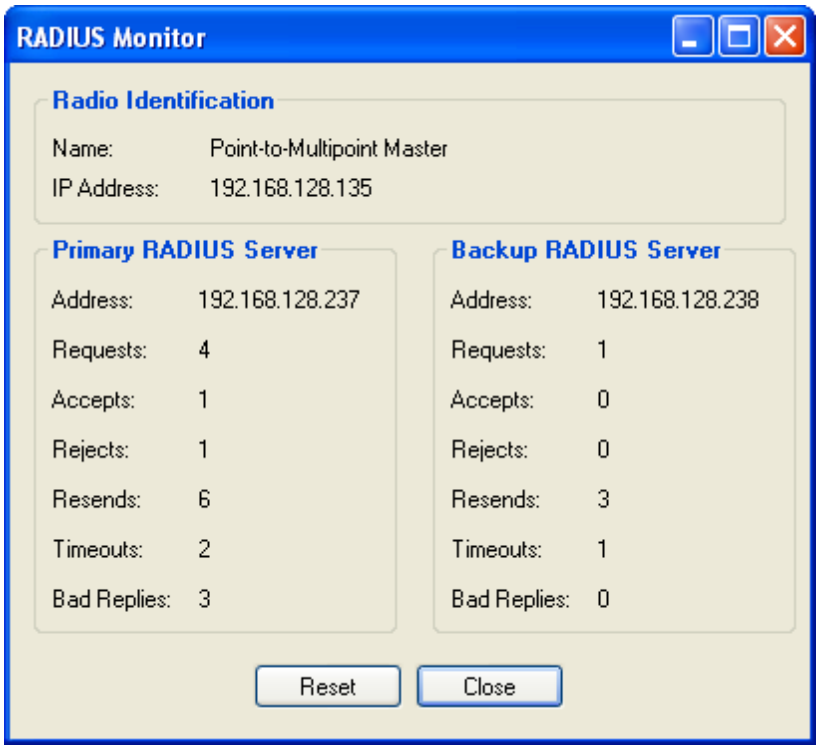
RADIUS Monitor

Select **RADIUS Monitor** from the **Radio** menu to display the current state of the RADIUS requests made by the radio.

When then **RADIUS Monitor** menu item is selected, the *RADIUS Monitor* form is displayed:



The following tables describe information displayed in the *RADIUS Monitor* form.

Radio Identification	
Field Name	**Description**
Name	The friendly name assigned to the radio.
IP Address	The IP address assigned to the radio.

Primary RADIUS Server / Backup RADIUS Server	
Field Name	**Description**
Address	The IP address of the RADIUS server against which the radio is authenticating.
Requests	The number of authentication requests made by the radio to the RADIUS server.

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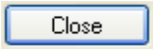
Accepts	The number of authentication requests that were accepted by the RADIUS server.
Rejects	The number of authentication requests that were rejected by the RADIUS server. This normally means that users tried to log in using invalid credentials (user name or password).
Resends	The number of times that the radio had to resubmit authentication requests. A large quantity of resends typically means that the RADIUS **Timeout** setting in the radio configuration form is too low, and needs to be increased.
Timeouts	The number of times that authentication requests timed out waiting for the RADIUS server to respond. This usually indicates that the RADIUS server could not be reached (e.g. the server may not be working, it may be blocked by a firewall, the RADIUS **Server Address** setting in the radio configuration form is incorrect).
Bad Replies	This normally indicates that the RADIUS **Shared Secret** setting in the radio configuration form is incorrect.

Reset Button	
	Click the **Reset** button to clear all of the RADIUS monitor statistics.
	Click the **Close** button to hide the RADIUS Monitor form.

The *RADIUS Monitor* form is used to help diagnose problems the radio is having accessing the RADIUS servers. The *Primary RADIUS Server* and *Backup RADIUS Server* panels will only be enabled if the associated RADIUS server is enabled in the radio's configuration form.

Refer to the following topics for more information on setting up the radio to use RADIUS for authentication:

- Broadband Radio RADIUS Settings
- Point-to-Point Radio RADIUS Settings
- Mesh Radio RADIUS Settings
- Point-to-Multipoint Radio RADIUS Settings

Refer to **ENCOM STRATOS RADIUS Configuration Guide**, available separately, for more information on setting up and using a RADIUS server with your radio network.

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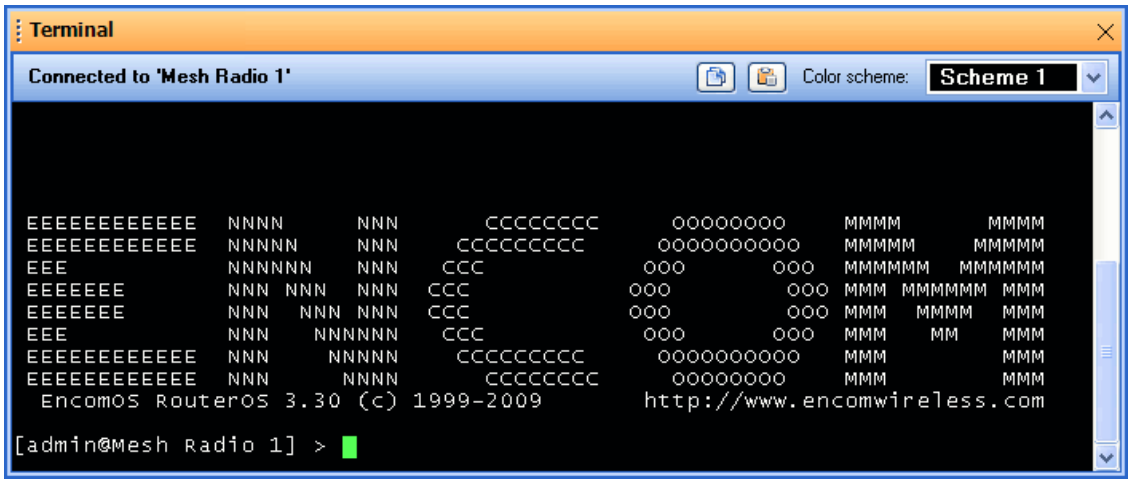
Terminal Connect

Select **Terminal Connect** from the **Radio** menu to log into the selected radio using a terminal window.

When the **Terminal Connect** menu item is selected, the *Terminal* panel is displayed:


Terminal
Connected to 'Mesh Radio 1'
Color scheme:
Scheme 1
EEEEEEEEEEEE NNNN NNN CCCCCCCC OOOOOOOO MMMM MMMM
EEEEEEEEEEEE NNNNN NNN CCCCCCCCC OOOOOOOOOO MMMMM MMMMM
EEE NNNNNN NNN CCC OOO OOO MMMMMM MMMMMM
EEEEEEE NNN NNN NNN CCC OOO OOO MMM MMMMMM MMM
EEEEEEE NNN NNN NNN CCC OOO OOO MMM MMMM MMM
EEE NNN NNNNNN CCC OOO OOO MMM MM MMM
EEEEEEEEEEEE NNN NNNNN CCCCCCCCC OOOOOOOOOO MMM MMM
EEEEEEEEEEEE NNN NNNN CCCCCCCC OOOOOOOO MMM MMM
EncomOS RouterOS 3.30 (c) 1999-2009
http://www.encomwireless.com
[admin@Mesh Radio 1] >

This panel allows you to interact with the radio using a text-based terminal interface.

Refer to the Terminal Panel topic for more information on using the terminal window.

Terminal Disconnect

Select **Terminal Disconnect** from the **Radio** menu to close and hide the terminal panel.

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Add

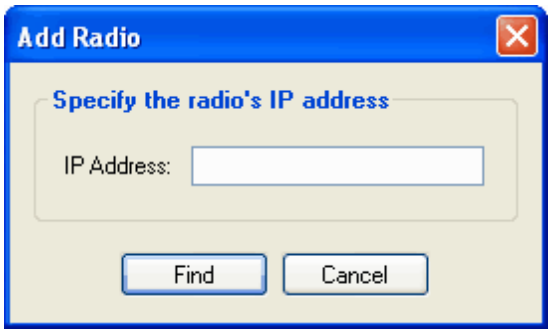
Select **Add** from the **Radio** menu to manually add a radio to the radio list.

This function is useful if a radio cannot be discovered by ENCOM STRATOS. This situation can occur if a router or firewall is blocking the radio heartbeat packets.

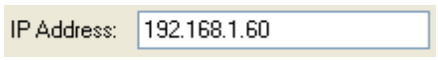
Note: In order for this function to work, STRATOS must be able to communicate with the radio via IP protocols. You must know the radio's IP address, and any routers or firewalls between the radio and STRATOS must be configured to let the appropriate services through (see the Network Setup topic for more details).

To manually add a radio to STRATOS application:

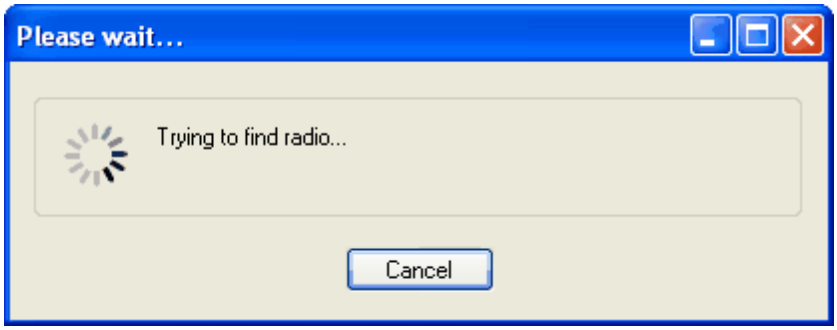
1. In the Radio List panel, select the folder in which the new radio will be added. (If you do not select a folder, the new radio will be added to the 'Default' folder.)
2. Select **Add** from the **Radio** menu. The *Add Radio* form is displayed:



3. Enter the radio's IP address in the **IP Address** field, as shown in the following example:



4. Click on the **Find** button.
5. A wait form is displayed while STRATOS probes for a radio at the IP address you specified.



6. If STRATOS is successful, the radio will be added to the radio list.

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Find

Select **Find** from the **Radio** menu to find radios within a specified range of IP addresses. This operation is also referred to as an IP sweep, since it will probe all of the IP addresses in the range you specify.

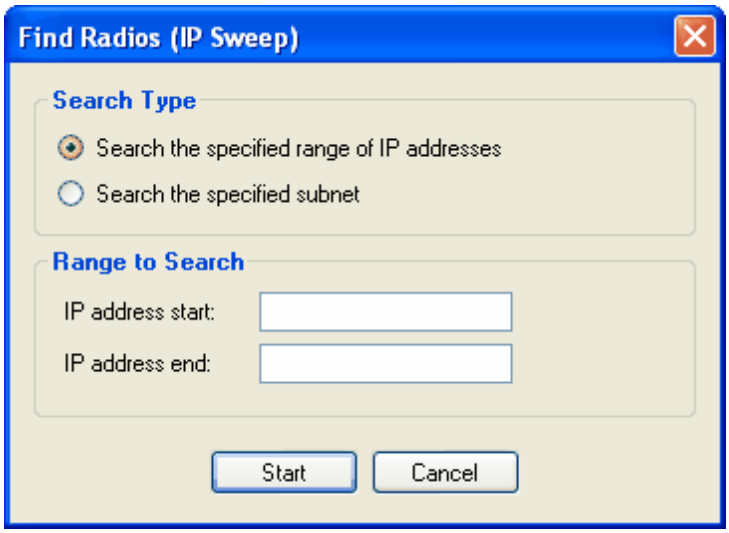
This function is useful if the radios cannot be discovered by ENCOM STRATOS. This situation can occur if a router or firewall is blocking the radio heartbeat packets.

Note: In order for this function to work, STRATOS must be able to communicate with the radios via IP protocols. Any routers or firewalls found between the radio and STRATOS must be configured to let the appropriate services through (see the Network Setup topic for more details).

To find the radios in a range of IP addresses:

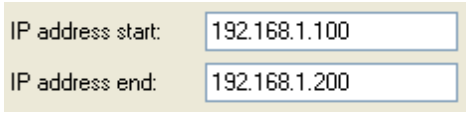
In the Radio List panel, select the folder in which the new radios will be added. (If you do not select a folder, the new radios will be added to the 'Default' folder.)

1. Select **Add** from the **Radio** menu. The *Find Radios* form is displayed:



2. Select the type of search you want to perform. Two options are available:

   If you select **Search the specified range of IP addresses**, you need to enter the start and end IP addresses in the **Range to Search** options, as shown in the following example:



   If you select **Search the specified subnet**, you need to enter the network address and the network mask in the **Range to Search** options, as shown in the following example:

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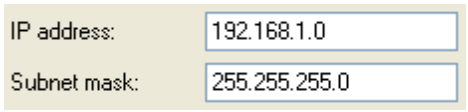
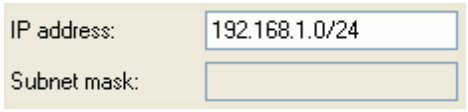
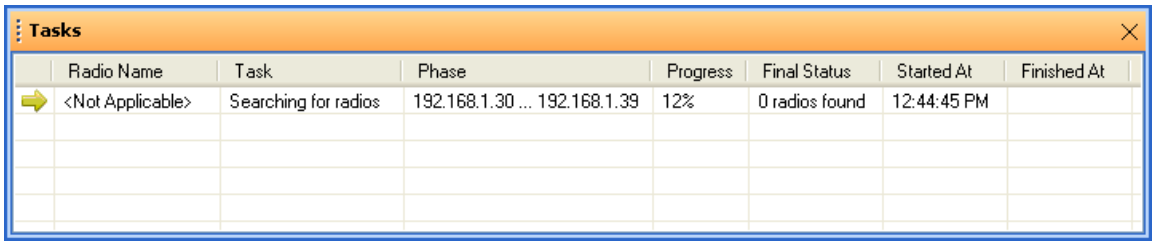


Alternatively, you can specify the IP address and network mask in CIDR format (IP Address/Mask Bits) in the **IP address** field. In this case, the **Subnet mask** field is not used, and is disabled:



All of these examples will perform the same search.

3. Click on the **Start** button.
4. The Task List panel will be activated and shown if it was hidden.
5. A new task will be added to the task list. It will show the progress of the search:



6. New radios will be added to the radio list as they are found.

> **NOTE** During the search, STRATOS will attempt to login to the radios using the credentials you specified in the Radio Login form. If a radio's login credentials are not the same, the login process will fail, and the radio will not be added to the radio list.

Delete

Select **Delete** from the **Radio** menu to remove the selected radio from the radio list. This function can be used to remove radios that are no longer active.

Note: If you remove an active radio from the list, STRATOS will add it back when it receives a heartbeat message from the radio.

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Assign Static IP Address

Select **Assign Static IP Address** from the **Radio** menu to change the radio's IP address.

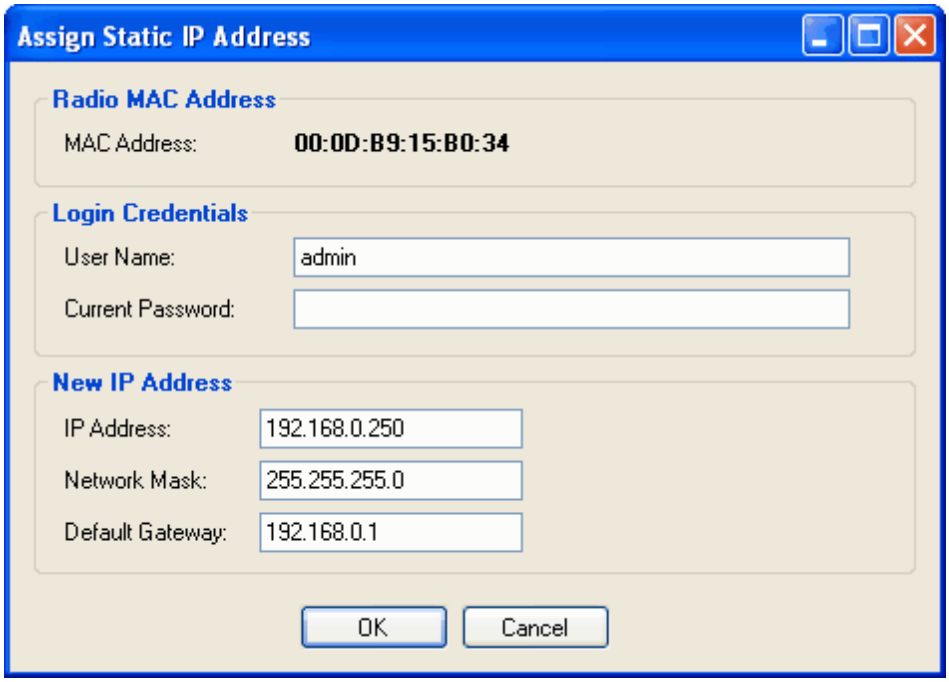
This function is used to change the IP address of a radio when its IP address is incompatible with the network on which STRATOS is running.

A common use for this function is to change the IP address of a radio that you have just received from ENCOM. A new radio will be configured with a default IP address (usually 192.168.0.250). If your local network is not compatible with the radio's default IP address, the radio may be discovered by STRATOS, but it will not be possible for STRATOS to communicate with it. You have to change the default address to an address that is compatible with your local network in order to be able to communicate with the radio.

Note: This function should not be used when STRATOS can communicate with the radio. In this case, use the Configure function to change the radio's IP address.

To assign a static IP Address to a radio:

1. Select the radio you want to change from the Radio List panel.
2. Select **Assign Static IP Address** from the **Radio** menu. The *Assign Static IP Address* form is displayed:



3. Enter the radio's login credentials in the **User Name** and **Current Password** fields.

   By default, the **User Name** is *admin* and the **Current Password** field is left blank.

4. Enter the radio's new IP address in the **IP Address** field, and a suitable network mask in the **Network Mask** field. You can also enter the address of the **Default Gateway** used by the radio to access services outside of the local network.

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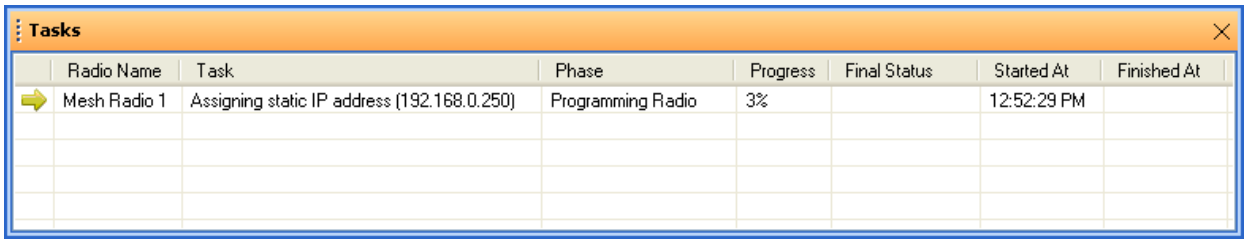
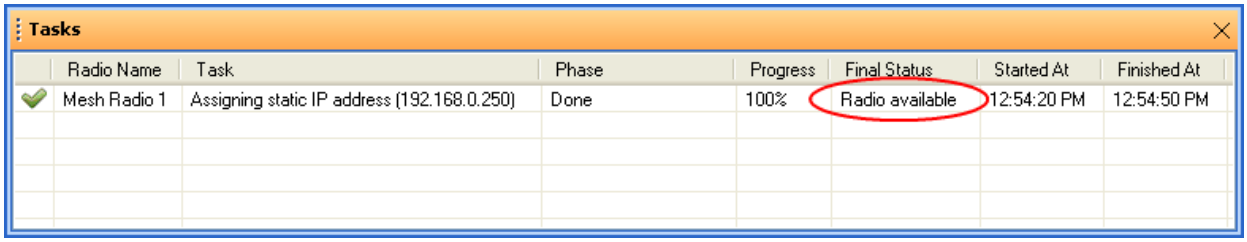
You should consult your I.T. department if you are not sure what to enter in these fields.

5. Click the **OK** button.
6. The Task List panel will be activated and shown if it was hidden.
7. A new task will be added to the task list. It will show the progress of the IP address assignment process:



8. If the assignment is successful, and STRATOS is able to communicate with the radio, the task item will indicate that the radio is available:



9. If the task was not successful, make sure that you are assigning a compatible IP address. Also, make sure that any routers or firewalls that are between the radio and STRATOS are configured properly (see the Network Setup topic for more details).

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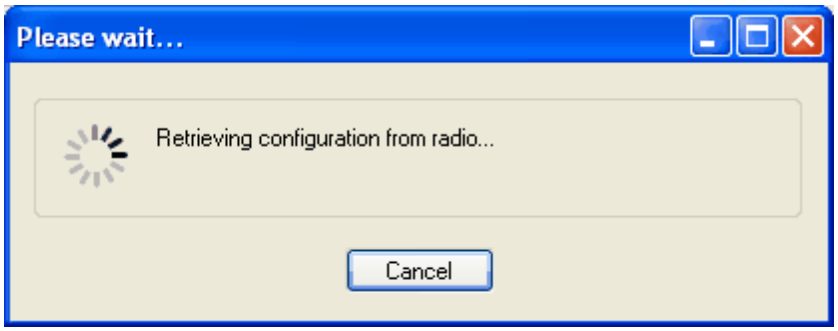
Restore to Factory Defaults

Select **Restore to Factory Defaults** from the **Radio** menu to return the radio to its initial from-the-factory state.

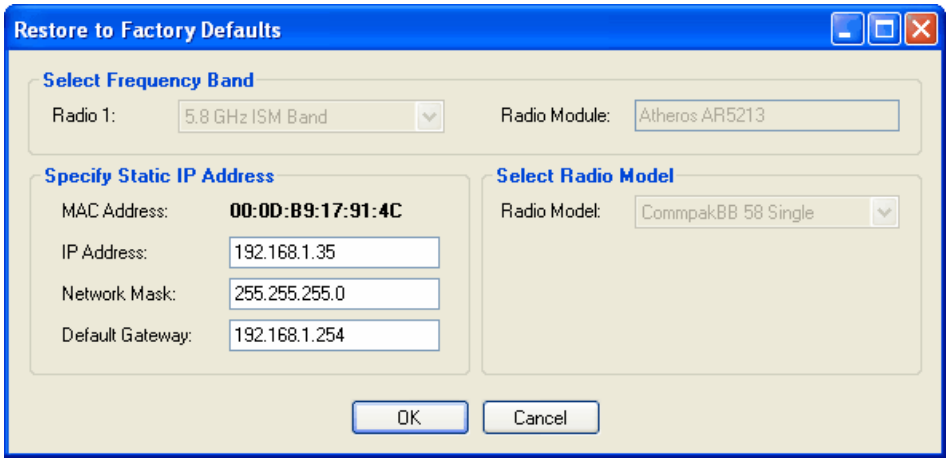
This function is useful if a radio has been misconfigured and is no longer working properly. This function will restore it to a basic operating state.

To restore a radio to its factory default configuration:

1. Select the radio you want to restore from the Radio List panel.
2. Select **Restore to Factory Defaults** from the **Radio** menu.
3. STRATOS will download the radio's current configuration.This process will normally take a few seconds to complete. During this time, a wait form is displayed:



4. When the radio's configuration has been obtained, the radio configuration form is displayed:



5. Under most circumstances, the **Frequency Band** and **Radio Model** fields are fixed and cannot be changed. In cases where they can be changed, select the appropriate options.
6. The **IP Address**, **Network Mask** and **Default Gateway** fields are populated with the radio's current settings. Make the appropriate changes as required.
7. Click the **OK** button.

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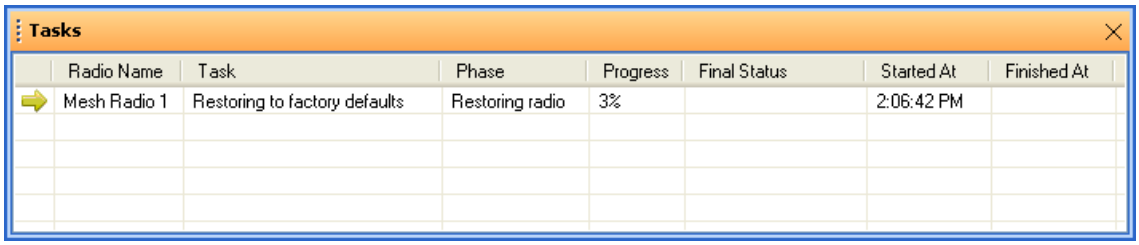
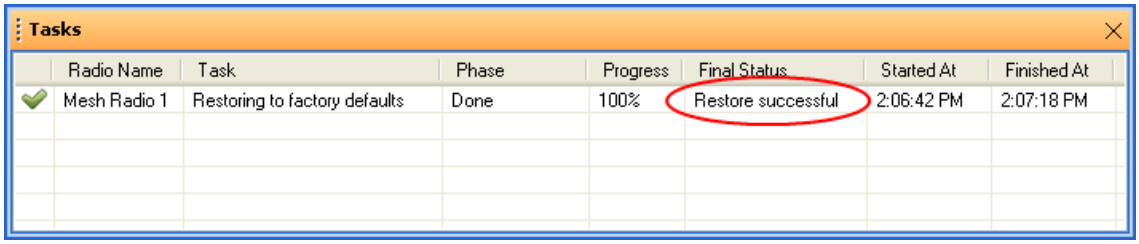
8. The Task List panel will be activated and shown if it was hidden.

9. A new task will be added to the task list. It will show the progress of the restore process:



10. If the restore process is successful, and STRATOS is able to communicate with the radio, the task item will indicate that the radio has been restored:



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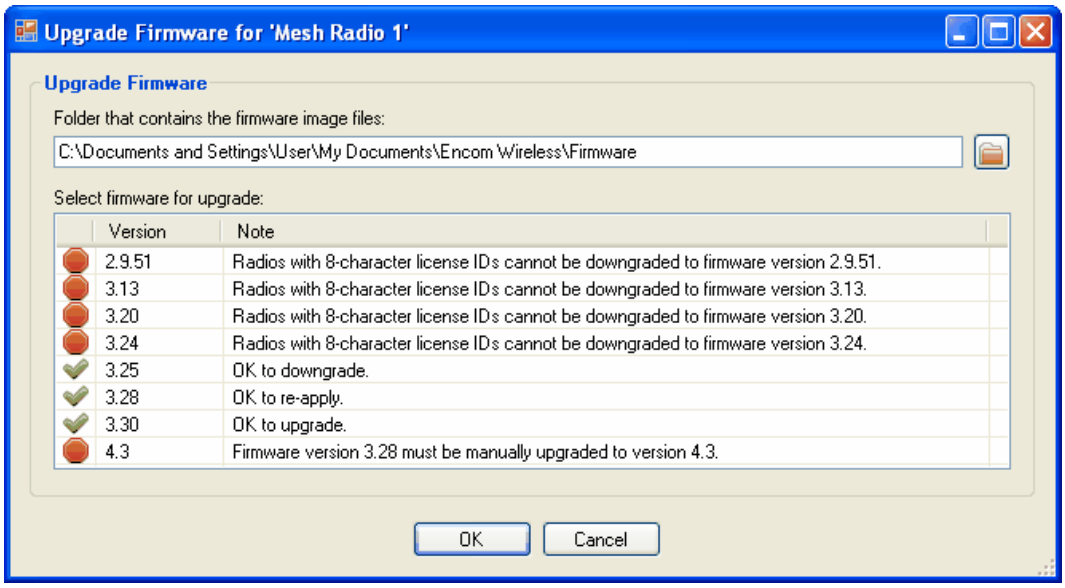
Upgrade Firmware

Select **Upgrade Firmware** from the **Radio** menu to upgrade (or downgrade) a radio's firmware.

Note: Upgrading or downgrading a radio will not affect its configuration. It is therefore safe to upgrade a radio that is installed in the field.

To upgrade a radio's firmware:

1. Select the radio you want to upgrade from the Radio List panel.
2. Select **Upgrade Firmware** from the **Radio** menu. The *Upgrade Firmware* form is displayed:


Upgrade Firmware for 'Mesh Radio 1'
Upgrade Firmware
Folder that contains the firmware image files:
C:\Documents and Settings\User\My Documents\Encom Wireless\Firmware
Select firmware for upgrade:
Version
Note
2.9.51
Radios with 8-character license IDs cannot be downgraded to firmware version 2.9.51.
3.13
Radios with 8-character license IDs cannot be downgraded to firmware version 3.13.
3.20
Radios with 8-character license IDs cannot be downgraded to firmware version 3.20.
3.24
Radios with 8-character license IDs cannot be downgraded to firmware version 3.24.
3.25
OK to downgrade.
3.28
OK to re-apply.
3.30
OK to upgrade.
4.3
Firmware version 3.28 must be manually upgraded to version 4.3.
OK
Cancel

   The form will display a list of all firmware available in the specified folder. Due to license restrictions enforced by the radio, not all firmware versions can be used for upgrade.

3. By default, STRATOS looks in the *'My Documents\Encom Wireless\Firmware'* folder for firmware upgrade files. If you have installed the upgrade files in a different folder, enter the folder name in the **Folder that contains the firmware image files** field, or click the button at the right of that field, and select the folder from the *Browse For Folder* form that is displayed.
4. Select the firmware version you want to upgrade or downgrade to.
5. Click the **OK** button.
6. The Task List panel will be activated and shown if it was hidden.

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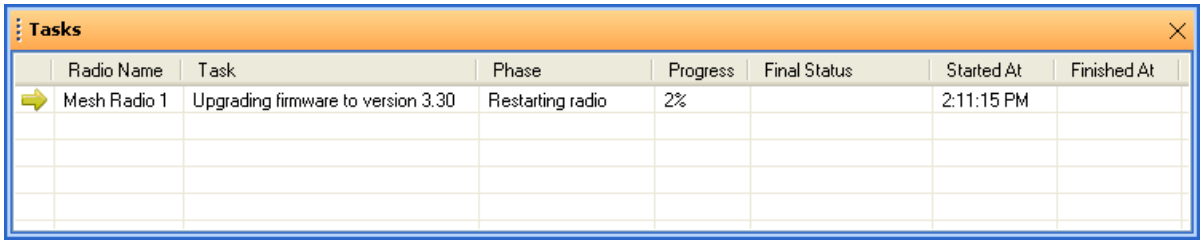
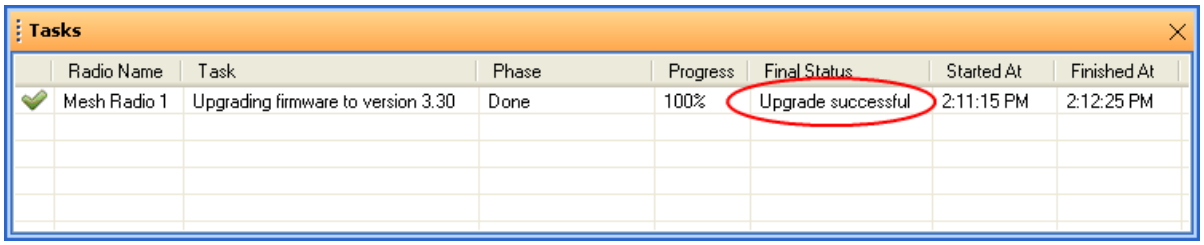
7. A new task will be added to the task list. It will show the progress of the upgrade process:



8. If the upgrade is successful, and STRATOS is able to communicate with the radio, the task item will indicate that the radio has been successfully upgraded:



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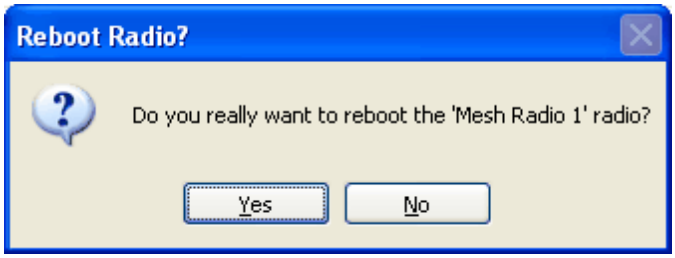
Reboot

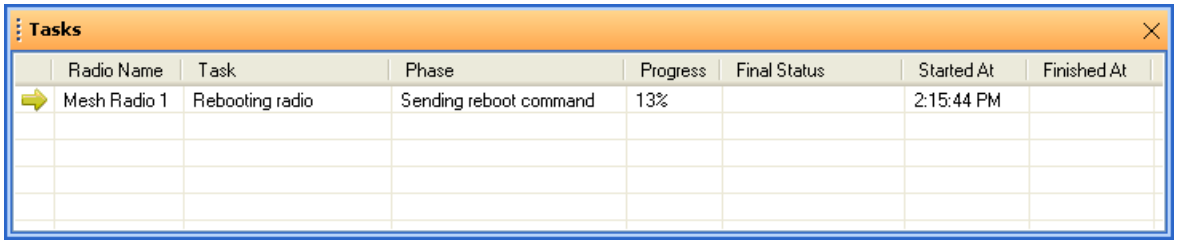
Select **Reboot** from the **Radio** menu to restart the selected radio.

To reboot a radio:

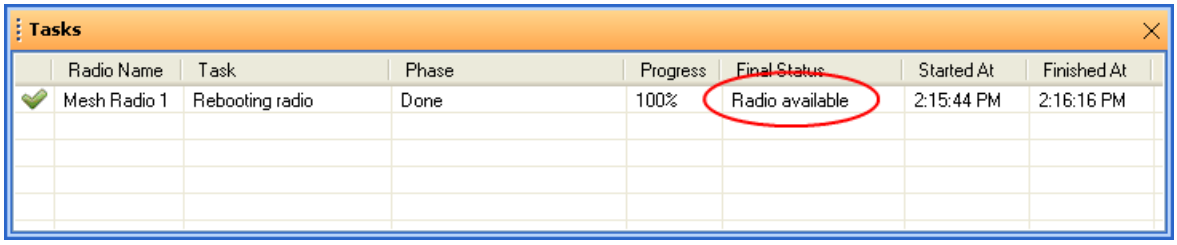
1. Select the radio you want to reboot from the Radio List panel.
2. Select **Reboot** from the **Radio** menu. You will be prompted for permission to reboot the radio:



3. Click the **Yes** button.
4. The Task List panel will be activated and shown if it was hidden.
5. A new task will be added to the task list. It will show the progress of the reboot process:



6. After the radio has been restarted and is back on-line, the task item will indicate that the radio has been successfully rebooted:



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Folder Menu Commands

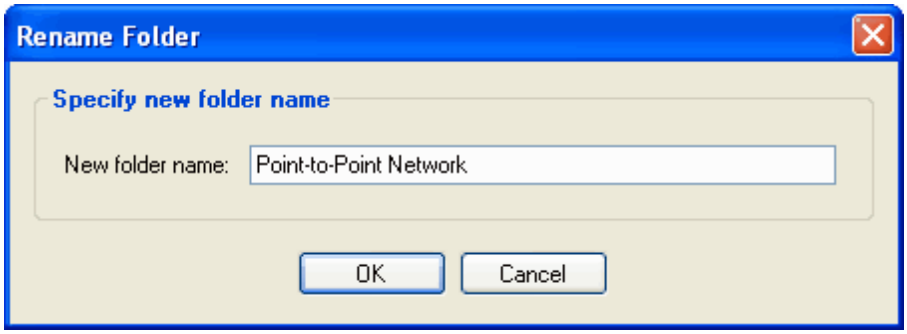
Rename

Select **Rename** from the **Folder** menu to change the name of the selected folder.

Note: You can rename any folder that you have created yourself. You cannot rename the *Default* folder that is created by ENCOM STRATOS.

To rename a folder:

1. Select the folder you want to rename from the Radio List panel.
2. Select **Rename** from the **Folder** menu. The *Rename Folder* form is displayed:



3. Enter the new folder name in the **New Folder Name** field.
4. Press **OK** to save the new folder name.

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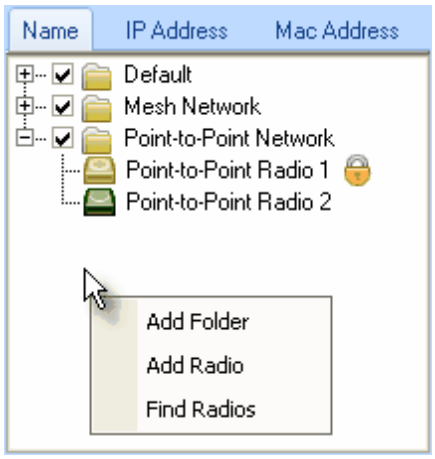
Add Folder

Select **Add Folder** from the **Folder** menu to add a new folder to the Radio List.

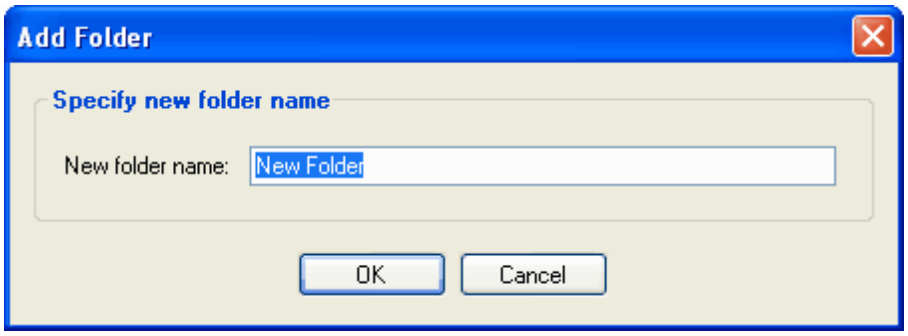
To add a new folder:

1. In the Radio List panel, select an existing folder in which to place the new folder.
2. Select **Add Folder** from the **Folder** menu.

   If you want to create a top level folder (a folder that is not contained in a parent folder), click the **right** mouse button outside of the radio list items, and select **Add Folder** from the pop-up menu that is displayed, as shown in the following example:



   The *Add Folder* form is displayed:



3. Enter the appropriate name in the **New Folder Name** field.
4. Press **OK** to create the new folder.

Delete

Select **Delete** from the **Folder** menu to delete the folder that is selected in the Radio List panel.

Note: You cannot delete a folder that contains radios (you must delete the radios that it contains first). Also, you cannot delete the *Default* folder that is created by ENCOM STRATOS.

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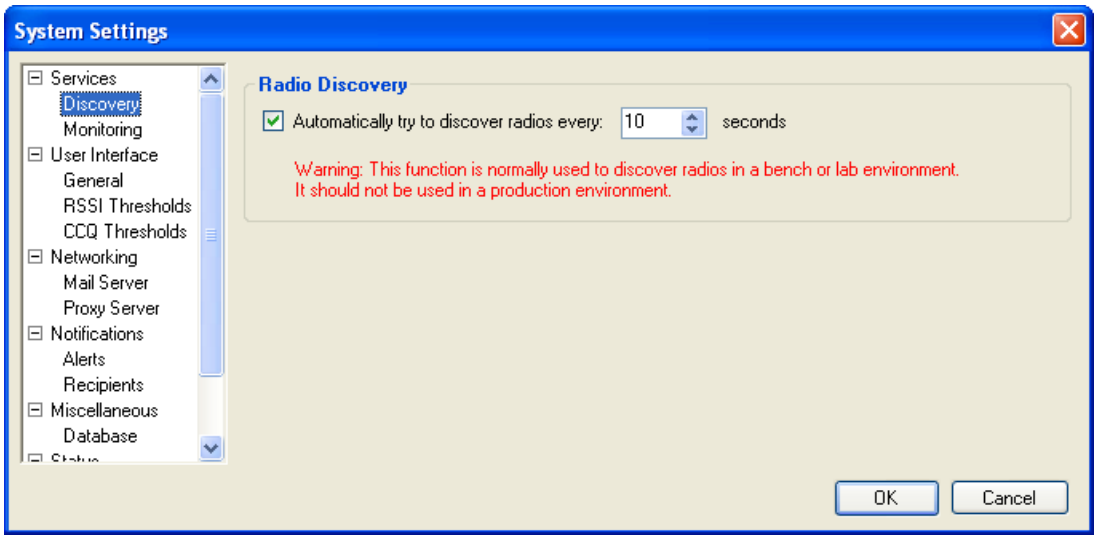
Tools Menu Commands

System Settings

Select **System Settings** from the **Tools** menu to display the *System Settings* form. This form allows you to configure a number of system options.



The system settings are logically grouped using a tree style interface. Click on an item in the tree to display the associated settings. The following topics describe the available settings:

- Services
  - Discovery
  - Monitoring
- User Interface
  - General
  - RSSI Thresholds
  - CCQ Thresholds
- Networking
  - Mail Server
  - Proxy Server
- Notifications
  - Alerts
  - Recipients
- Miscellaneous
  - Database
- Status
  - Logging

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- Performance

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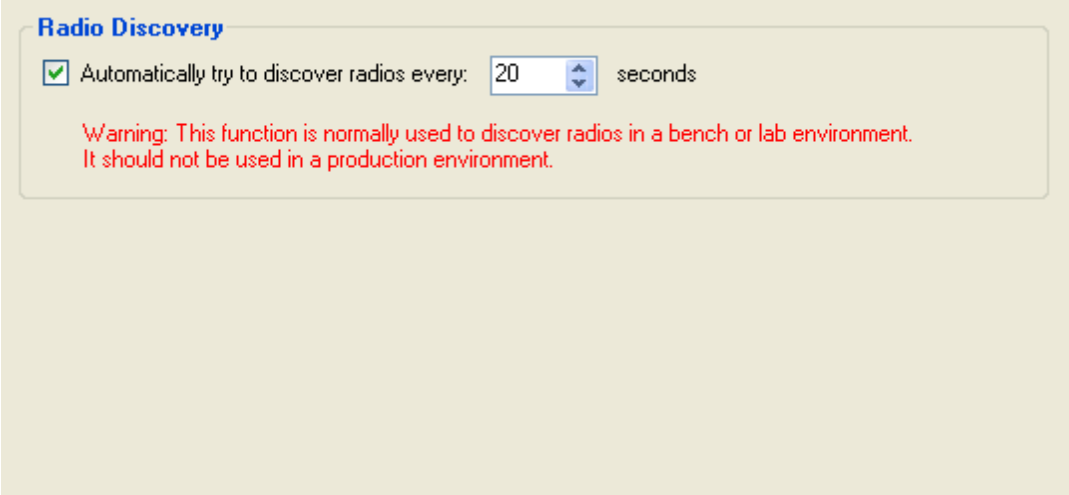
Services - Discovery

The following screen shot shows the *Discovery* panel of the *System Settings* form:


Radio Discovery
Automatically try to discover radios every:
20
seconds
Warning: This function is normally used to discover radios in a bench or lab environment.
It should not be used in a production environment.

The following table describes the individual discovery settings.

Radio Discovery	
Field Name	**Description**
Automatically try to discover radios every...	Under normal operation, ENCOM radios generate a heartbeat message every minute. Heartbeat messages are used by ENCOM STRATOS to determine if a new radio has appeared on the network. If the heartbeat from a new radio is received, STRATOS automatically adds the radio to the Radio List. In certain cases, such as a bench configuration or testing environment, it may not be practical to wait for the self-generated heartbeat to be received. Checking this option will cause STRATOS to actively request heartbeat messages at the specified frequency. This can significantly reduce the amount of time you have to wait for the radio to be discovered by STRATOS. **Note:** This feature is of little value in a production environment, and could cause a slight degradation in performance in larger networks. It should therefore be left disabled in such an environment.

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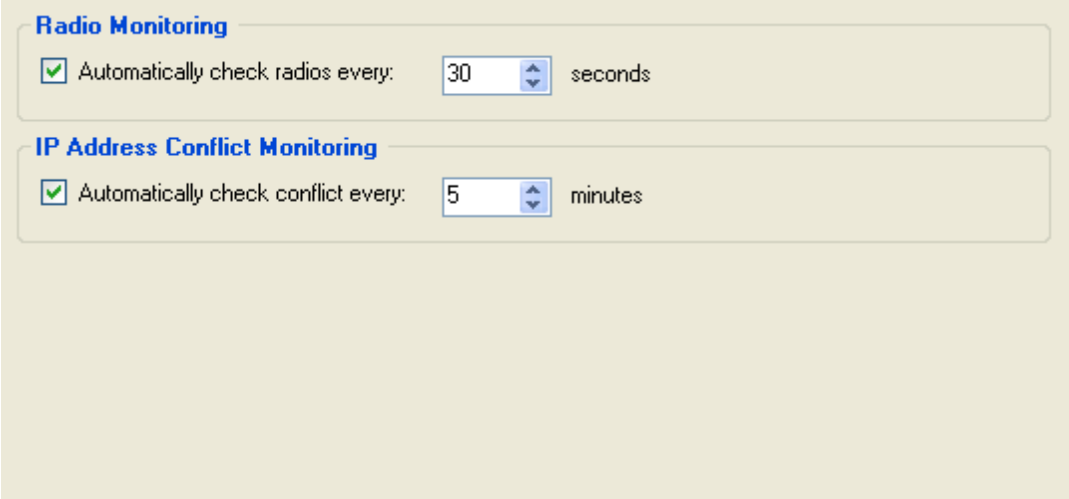
Services - Monitoring

The following screen shot shows the *Monitoring* panel of the *System Settings* form:



The following table describes the individual monitor settings.

Radio Monitoring	
Field Name	**Description**
Automatically check radios every...	Check this option to periodically verify that the radios in the network are on-line, and to determine the wireless links present between the radios. When this option is enabled STRATOS will send ping requests to all of the radios in the network at the specified frequency. Radios that respond will be shown as being on-line in the Radio List panel (green or yellow state icon). Radios that do not respond will be shown as off-line (red state icon). As well, the lines on the map that show the wireless connections between the radios will be updated to reflect the current condition of the wireless links. **Note:** Because this feature is important to the operation of the STRATOS network monitoring functions, it should not be disabled.

IP Address Conflict Monitoring	
Field Name	**Description**
Automatically check conflict every...	Check this option to periodically check for IP address conflicts (where two or more radios that have been assigned the same IP address). If an IP address conflict is detected, an IP Address Conflict form is

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	displayed that indicates the radios that have been assigned the same IP address. **Note:** This feature only checks for IP address conflicts between ENCOM radios. Other devices in the network (such as cameras, traffic controllers and other devices) could be assigned the same IP address, but STRATOS would not be able to detect such conflicts.

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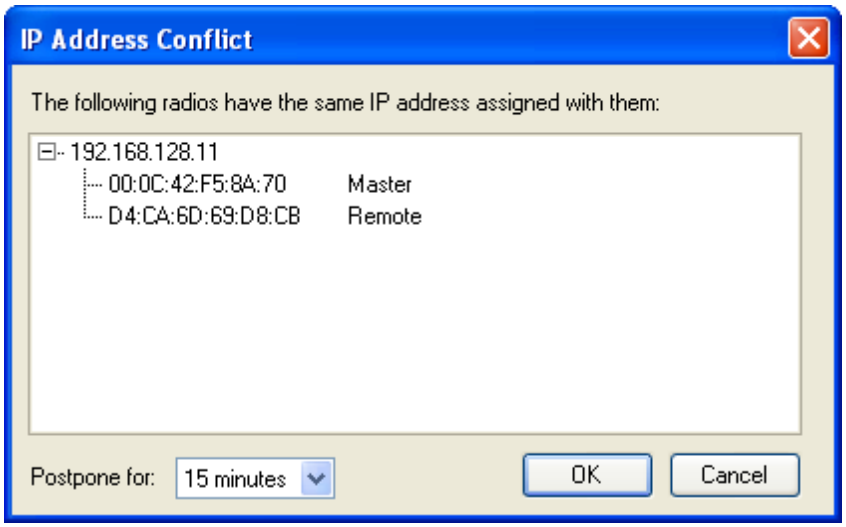
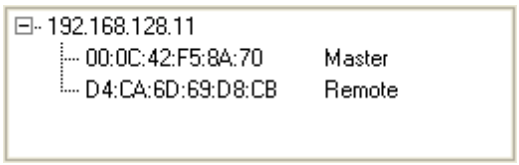
The *IP Address Conflict* form displays the radios that have been assigned the same IP address, as shown in the following example:



The following table describes the fields found in the *IP Address Conflict* form.

Field Name	Description
IP address conflict list	The IP address conflict list shows the IP addresses that are in conflict, and the MAC addresses and names of the radios that have been assigned the same IP address.  See the Recovering from an IP Address Conflict topic for information on addressing the issue.
Postpone for...	Select the amount of time to wait before the *IP Address Conflict* form is re-displayed (if the address conflict has not been resolved).
OK button	Press the **OK** button to postpone the re-display of the *IP Address Conflict* form (if the address conflict has not been resolved).
Cancel button	Press the **Cancel** button to close the *IP Address Conflict* form. The form will be re-displayed at the next IP Address Check interval if the address conflict is not resolved.

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If radios are assigned the same IP address, STRATOS will have great difficulty interacting with them. Anything that communicates with the radio via its IP address, including the radio configuration form, will not work reliably. Because of this, you will need to change the IP address of the radios so that they are no longer in conflict. One or more of the following procedures can be used to do this:

1. If there is no router between the computer running STRATOS and the radios, use the Assign Static IP Address function to change the IP address of one or more or the radios that are in conflict.

2. If you cannot use the Assign Static IP Address function:

   a) Power off all but one of the radios that are in conflict.

   b) Change the IP address of the radio that is still powered using the radio configuration form.

   a) Repeat steps a-b for the remaining radios that are in conflict.

3. If one or more of the radios that are in conflict are no longer present on the network (e.g. they were being used for testing or were replaced by a new radio), simply delete them from the radio list.

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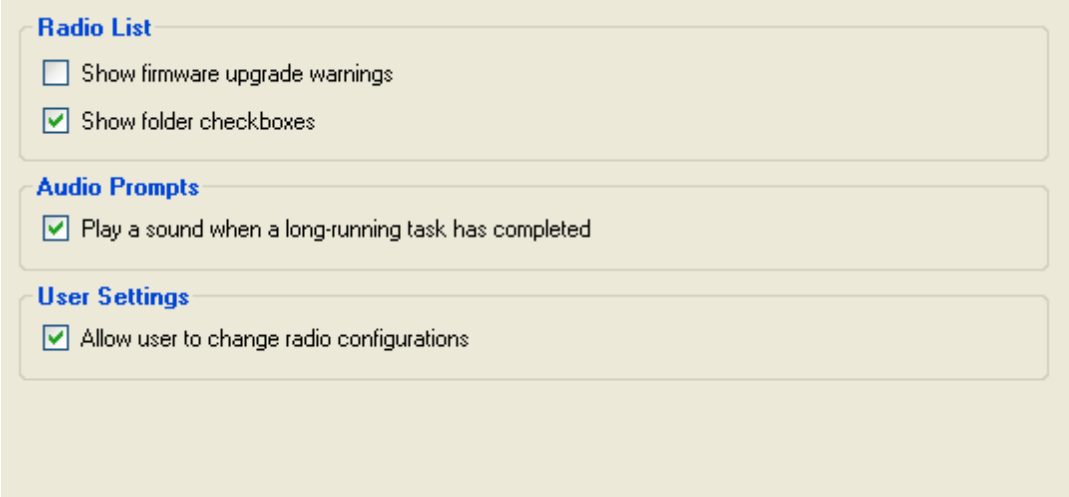
User Interface - General

The following screen shot shows the *General* panel of the *System Settings* form:


Radio List
Show firmware upgrade warnings
Show folder checkboxes
Audio Prompts
Play a sound when a long-running task has completed
User Settings
Allow user to change radio configurations

The following table describes the individual user interface settings.

Radio List	
Field Name	**Description**
Show firmware upgrade warnings	If checked, warning indicators (small triangular icons) are displayed in the Radio List panel to let you know that a radio's firmware should be upgraded to the recommended version. If not checked, the warning indicators are only displayed if a radio's firmware **must** be upgraded in order to be compatible with ENCOM STRATOS.
Show folder checkboxes	If checked, checkboxes will be displayed next to the folders in the radio list panel, as shown in the example below. Radio icons will be displayed on the map view panel only if: • A valid geographical location has been assigned to the radio. • The checkbox associated with the folder that contains the radio is checked.

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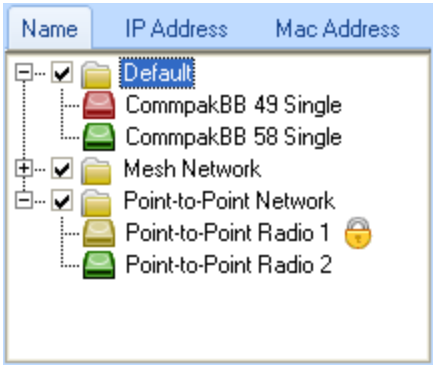
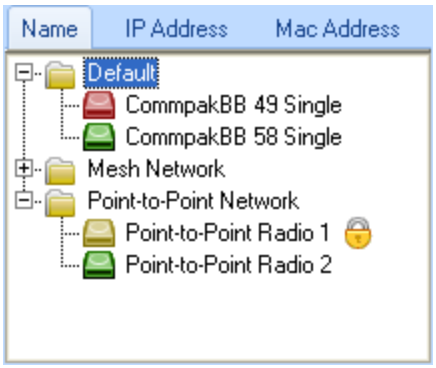
	 If not checked, checkboxes are not displayed in the radio list panel, as shown in the example below. Icons for all radios that have been assigned valid geographical locations will be shown on the map view panel.  Radios are assigned a geographical location in the Location tab of the Radio Configuration form.

Audio Prompts	
Field Name	**Description**
Play a sound when a long-running task has completed	If checked, STRATOS will beep when a task that takes a significant amount of time to complete is finished. Examples of such tasks include: • Assign Static IP Address • Upgrade Firmware • Find Radios

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User Settings	
Field Name	**Description**
Allow user to change radio configurations	If checked, ENCOM STRATOS will allow you to modify the configuration of any radio that is on-line. If not checked, STRATOS will not allow you to modify the configuration of any radio. However, you will still be able to view the current configuration of radios that are on-line. Disabling this feature provides a handy way to prevent users from making changes to the radio's configuration, but still allow them to view the radio's current configuration.

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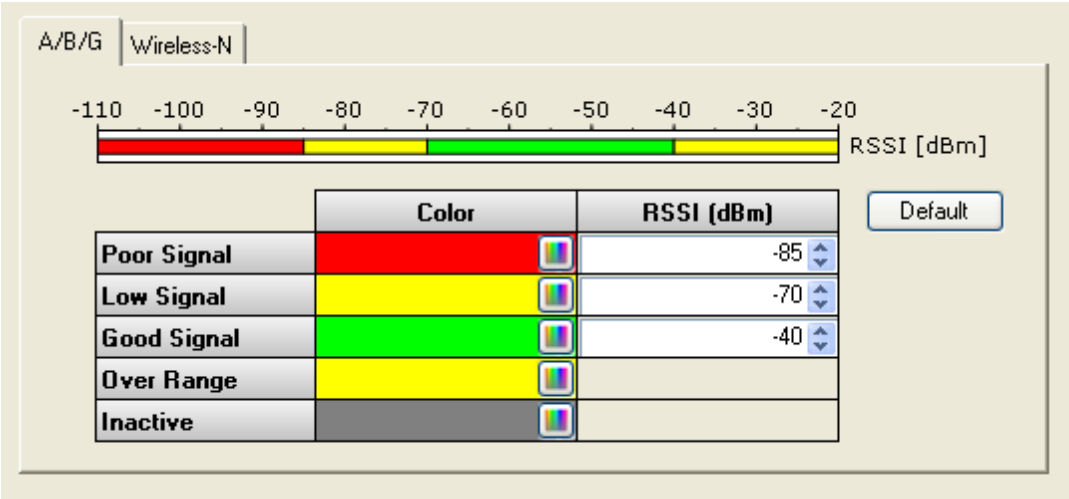
User Interface - RSSI Thresholds

The following screen shot shows the *RSSI Thresholds* panel of the *System Settings* form:



The RSSI threshold settings allow you to specify the colors to use for the following items in the STRATOS user interface:

- Wireless Link Status panel Status column
- Wireless Link Status panel RSSI bars
- Map View wireless link connection lines

Because of differences between the two technologies, different thresholds are used for the Wireless-N and legacy A/B/G radio cards. Click the **Wireless-N** tab to access the Wireless-N settings, and click the **A/B/G** tab to access the legacy radio card settings.

The following table describes the individual RSSI threshold settings. Note that for all settings:

- To change the color, click the associate button in the **Color** column, and select the desired color from the color picker that is displayed.
- To change the threshold, enter a new value in the **RSSI (dBm)** column, or click on the buttons to change the value.

Setting Name	Description
Poor Signal	Set the color to display when the signal strength is less than the specified RSSI value. An RSSI value below the **Poor Signal** threshold indicates that the signal strength is too low. The connection will probably not be stable, and will have low throughput.

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Low Signal	Set the color to display when the signal strength is less than the specified RSSI value, but higher than the **Poor Signal** value. An RSSI value between the **Poor Signal** and **Low Signal** thresholds indicates that the signal strength is low. The connection will be marginal, and may not have good throughput.
Good Signal	Set the color to display when the signal strength is less than the specified RSSI value, but higher than the **Low Signal** value. An RSSI value between the **Low Signal** and **Good Signal** thresholds indicates that the signal strength is optimal. The wireless connection should be stable, and will have good throughput.
Over Range	Set the color to display when the signal strength is greater than the **Good Signal** value. An RSSI value above the **Good Signal** threshold indicates that the signal strength is too high. The connection may not be stable, and may not have good throughput.
Inactive	Set the color to display when no signal strength information is available for a static link (i.e. the link is defined, but there is no wireless connection between the radios). Static links can be defined for Broadband or Point-to-Multipoint radios. Either define a static WDS link (for master radios) or specify a parent radio (for remotes). For Broadband radios, refer to the following topics: • Broadband Radio WDS Setup • Broadband Remote Radio Setup For Point-to-Multipoint radios, refer to the following topics: • Point-to-Multipoint Radio WDS Setup • Point-to-Multipoint Remote Radio Setup
Default button	Click the **Default** button to restore the color and threshold settings to their factory default values.

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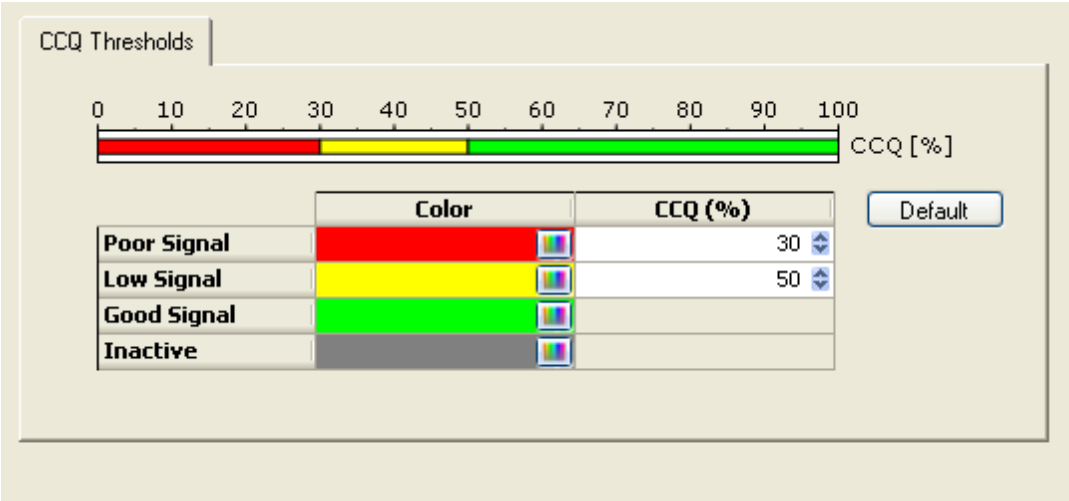
User Interface - CCQ Thresholds

The following screen shot shows the *CCQ Thresholds* panel of the *System Settings* form:



The CCQ threshold settings allow you to specify the colors to use for the following items in the STRATOS user interface:

- Wireless Link Status panel CCQ bars
- Map View wireless link connection lines

The following table describes the individual CCQ threshold settings. Note that for all settings:

- To change the color, click the associate button in the **Color** column, and select the desired color from the color picker that is displayed.
- To change the threshold, enter a new value in the **CCQ (%)** column, or click on the buttons to change the value.

Setting Name	Description
Poor Signal	Set the color to display when the signal quality is less than the specified CCQ value. A CCQ value below the **Poor Signal** threshold indicates that the signal quality is bad. The connection will probably not be stable, and will have low throughput.
Low Signal	Set the color to display when the signal quality is less than the specified CCQ value, but higher than the **Poor Signal** value. A CCQ value between the **Poor Signal** and **Low Signal** thresholds indicates that the signal quality is low. The connection will be marginal,

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	and may not have good throughput.
Good Signal	Set the color to display when the signal quality is greater than the **Low Signal** value. A CCQ value above the **Low Signal** value indicates that the signal quality is good. The wireless connection should be stable, and will have good throughput.
Inactive	Set the color to display when no signal strength information is available for a static link (i.e. the link is defined, but there is no wireless connection between the radios). Static links can be defined for Broadband or Point-to-Multipoint radios. Either define a static WDS link (for master radios) or specify a parent radio (for remotes). For Broadband radios, refer to the following topics: • Broadband Radio WDS Setup • Broadband Remote Radio Setup For Point-to-Multipoint radios, refer to the following topics: • Point-to-Multipoint Radio WDS Setup • Point-to-Multipoint Remote Radio Setup
Default button	Click the **Default** button to restore the color and threshold settings to their factory default values.

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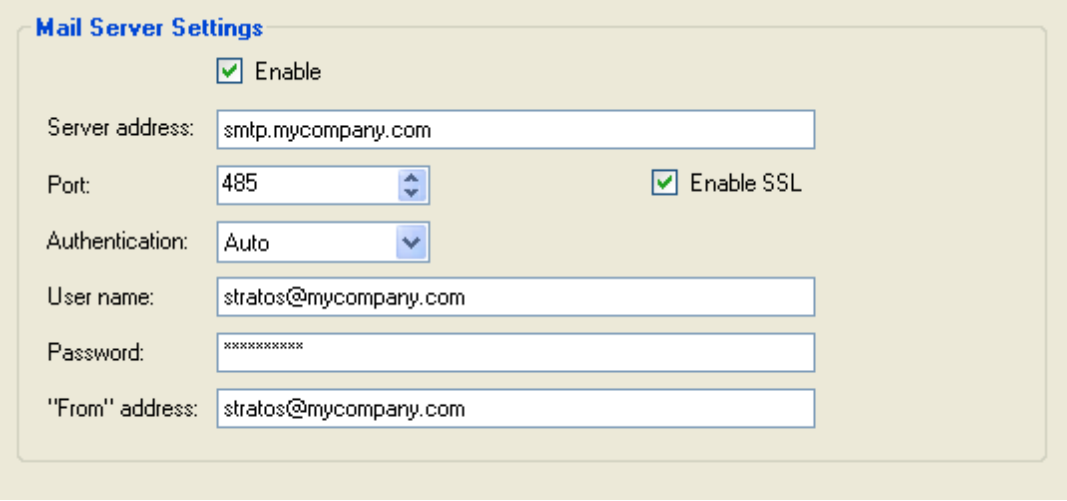
Networking - Mail Server

STRATOS supports an alerting mechanism that is able to send emails to specific recipients when a network event occurs (a radio going off-line, the strength of a wireless signal being too low, etc.). In order to send out the emails, STRATOS requires access to an SMTP (Simple Mail Transfer Protocol) mail server.

Configuring the mail server settings requires knowledge of your network environment, and of the mail server in particular. You will need to consult your I.T. department for the required settings.

The following screen shot shows the *Mail Server* panel of the *System Settings* form:



The following table describes the individual mail server settings.

Mail Server Settings	
Field Name	**Description**
Enable	If checked, STRATOS will attempt to send notification e-mails to the a list of recipients when an alert is generated. Recipients are defined in the Recipients panel of the *System Settings* form. Alerts are configured in the Alerts panel of the System Settings form.
Server Address	Enter the address of the SMTP server. This can be specified as an IP address (192.168.1.100) or a DNS name (smtp.mycompany.com).
Port	Enter the IP port on which the SMTP server accepts connections for outgoing mail.
Enable SSL	Check this setting if the SMTP server requires that connections be secured by SSL.

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<table>
<tr><td>Authentication</td><td>Select the type of authentication required by the SMTP server. One of the following options can be used:

<table>
<tr><th>Authentication</th><th>Description</th></tr>
<tr><td>None</td><td>No authentication is required. No user name or password are specified.</td></tr>
<tr><td>Auto</td><td>Automatically chooses the best authentication method available. Note that this option may not always work. You may need to select a specific authentication type instead.</td></tr>
<tr><td>Plain</td><td>PLAIN authentication is used (the user name and password are not encrypted).</td></tr>
<tr><td>Digest-MD5</td><td>DIGEST-MD5 authentication is used.</td></tr>
<tr><td>CRAM-MD5</td><td>CRAM-MD5 authentication is used.</td></tr>
<tr><td>Login</td><td>LOGIN authentication is used (the user name and password are not encrypted).</td></tr>
<tr><td>NTLM</td><td>Authentication used by Microsoft servers.</td></tr>
<tr><td>GSSAPI</td><td>Kerberos-based authentication.</td></tr>
</table>
</td></tr>
<tr><td>User Name</td><td>Enter the user name used to log into the SMTP server. This is often the user name of an account created on the mail server specifically for STRATOS.</td></tr>
<tr><td>Password</td><td>Enter the password used to log into the SMTP server.</td></tr>
<tr><td>"From" Address</td><td>Enter the e-mail address that will be used to identify the source of the e-mail. This is often the e-mail address of an account created on the mail server specifically for STRATOS.</td></tr>
</table>

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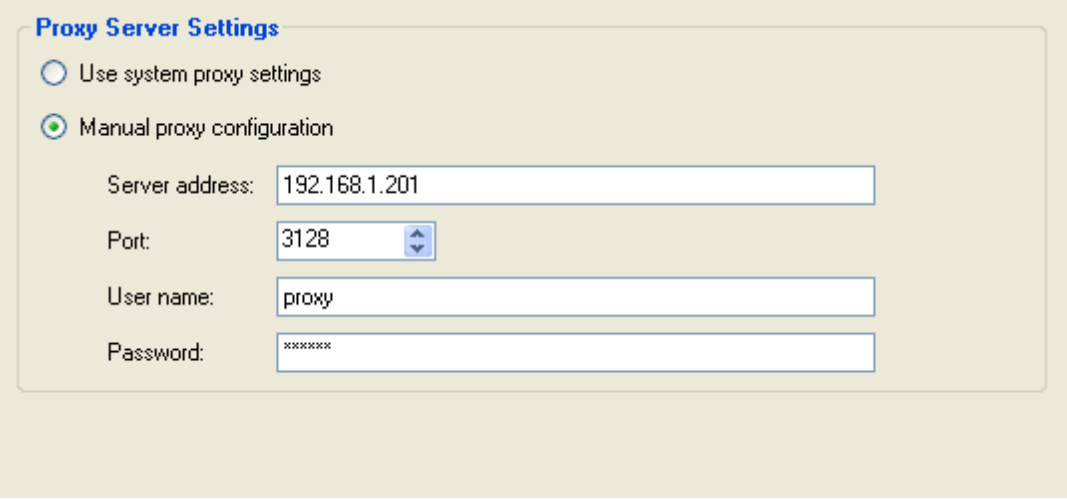
Networking - Proxy Server

The Map View panel requires an Internet connection to access the map tiles from the various map service providers. If the computer on which STRATOS is running is directly connected to the Internet, there is usually no problem in accessing the tiles. If a proxy server is being used, and your computer is properly configured, STRATOS can normally make use of the system proxy settings to access the tiles via the proxy server.

In some cases, STRATOS may not be able to use your computer's proxy settings, and will not be able to access the Internet. In such cases, you may need to configure the proxy settings manually to gain access to the map tiles.

Configuring the proxy settings requires knowledge of your network environment, and of the proxy server in particular. You will need to consult your I.T. department for the required settings.

The following screen shot shows the *Proxy Server* panel of the *System Settings* form:



The following table describes the individual proxy server settings.

Proxy Server Settings	
Field Name	**Description**
Use system proxy settings	This is the default setting. STRATOS will attempt to access the Internet using your computer's proxy settings.
Manual proxy configuration	Select this option if STRATOS is not able to access the map tiles. You will need to configure the remaining options in order to access the Internet through your proxy server.
Server Address	Enter the IP or DNS address of your proxy server.
Port	Enter the port number (on the proxy server) used to access the Internet using the HTTP protocol.

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User Name	Enter the user name used to authenticate with the proxy server (if authentication is used).
Password	Enter the password used to authenticate with the proxy server (if authentication is used).

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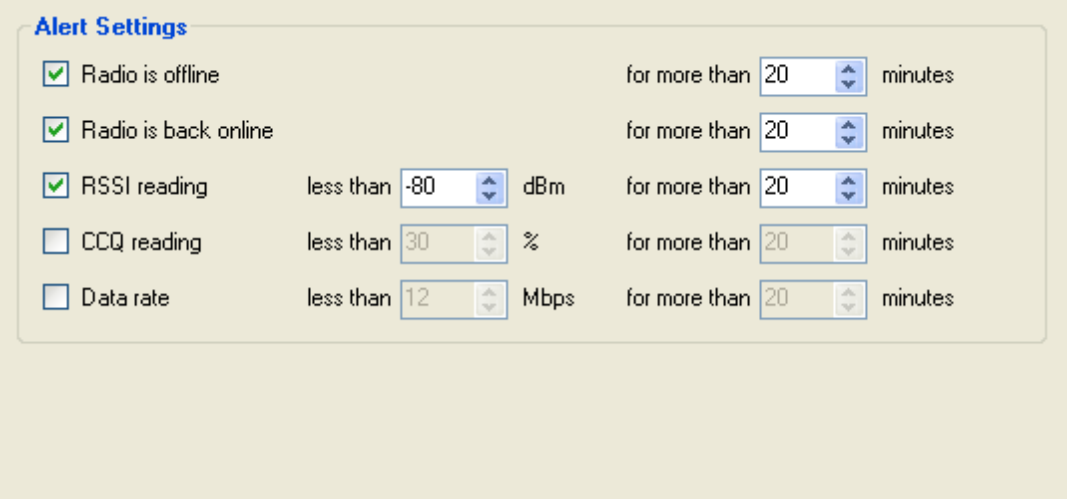
Notifications - Alerts

STRATOS can generate a number of alerts that notify you of problems with your network.

When an alert condition is occurs, STRATOS will:

- Add the alert to the Alerts panel (and automatically show the panel).
- If the Mail Server is enabled, send a notification e-mail to each recipient in the Recipients list.

The following screen shot shows the *Alert Settings* panel of the *System Settings* form:



The following table describes the individual alert settings.

Alert Settings	
Field Name	**Description**
Radio is offline	Check this option to get notified that a radio has been offline for the specified amount of time.
Radio is back online	Check this option to get notified that a radio has been online for the specified amount of time. This alert is only generated if a **Radio is offline** alert was previously generated for the radio.
RSSI reading	Check this option to get notified that the signal strength of one or more wireless links have been lower than the specified value for the specified amount of time.
CCQ reading	Check this option to get notified that the signal quality of one or more wireless links have been lower than the specified value for the specified amount of time.

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Data rate	Check this option to get notified that the data rate of one or more wireless links have been lower than the specified value for the specified amount of time.

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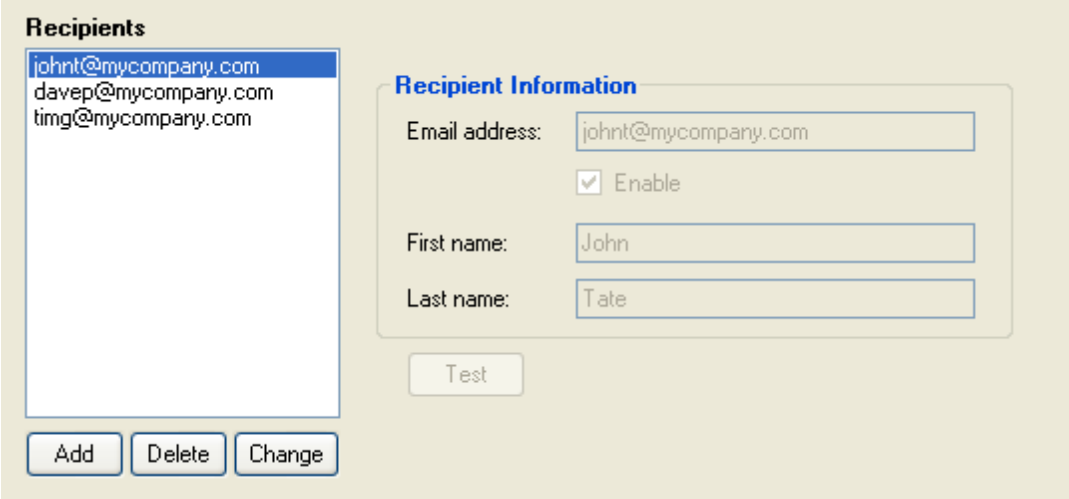
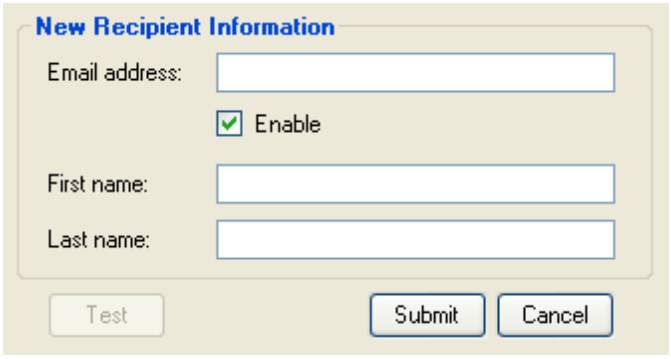
Notifications - Recipients

The following screen shot shows the *Recipients* panel of the *System Settings* form:



The following table describes the individual recipient settings.

Recipient List	
Field Name	**Description**
Recipient list	Contains the list of recipients that have been defined. Notifications will be sent to all recipients in the list if the mail server and the recipient are enabled.
Add button	Click the **Add** button to add a new recipient to the list. When clicked, the **Recipient Information** panel is enabled:  Enter the appropriate information, and click the **Submit** button to add the new recipient to the list. If you do not wish to add a new recipient, click the **Cancel** button.
Delete button	Click the **Delete** button to remove the selected recipient from the list.

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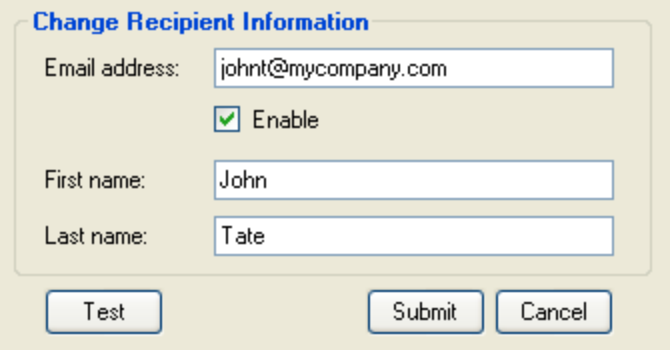
Change button	Click the Change button to change the information associated with the selected recipient. When clicked, the **Recipient Information** panel is enabled, and the recipient's information displayed:  Make the appropriate changes, and click the **Submit** button to save the changes. If you do not wish to make changes, click the **Cancel** button.

Recipient Information	
Field Name	**Description**
Email address	Enter the email address of the recipient.
Enable	Check this setting to enable the recipient. Notification message are only sent to enabled recipients.
First name	Enter the first name of the recipient.
Last name	Enter the last name of the recipient.
Test button	Click the **Test** button to send a test email to the recipient using the SMTP server specified in the Mail Server panel. The **Test** button is disabled if the mail server is not enabled.
Submit button	Click the **Submit** button to accept a new recipient, or changes made to an existing recipient.
Cancel button	Click the **Cancel** button if you do not want to add or change a recipient.

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Miscellaneous - Database

The following screen shot shows the *Database panel* of the *System Settings* form:

The following table describes the individual database settings.

Radio Database	
Field Name	**Description**
Automatically save radio information to the database	When checked, ENCOM STRATOS will automatically save all of the radio information that it has collected to a database. When STRATOS is shut down and subsequently run, it will use this stored information to populate the Radio List panel, Map View panel and other user interface elements. It will also allow you to view the last known configuration of radios that are off-line. If this option is not checked, no radio data is saved. If STRATOS is shut down and subsequently run, the radio list will be empty. Disabling this option is useful in factory and bench provisioning settings, where it is not desirable to retain the list of radios that have been configured by STRATOS.

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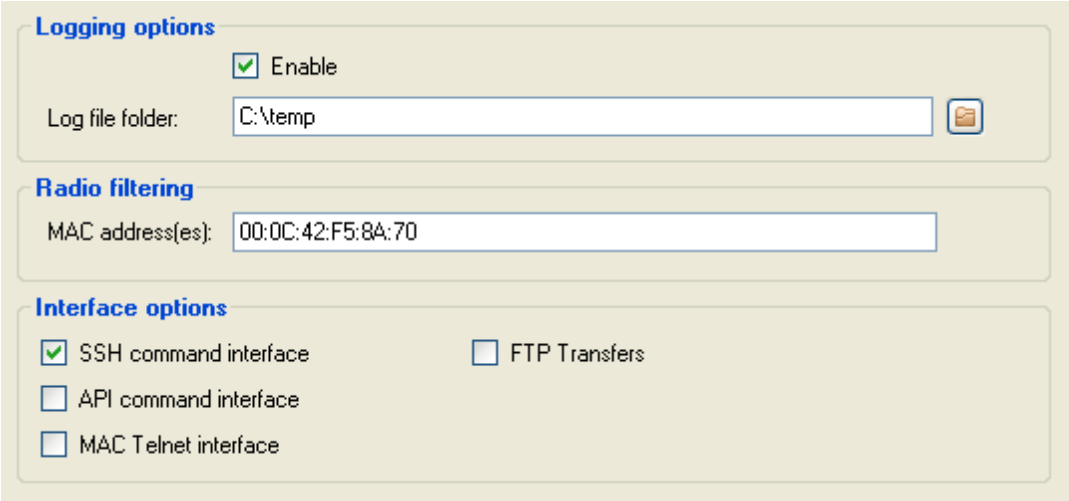
Status - Logging

STRATOS allows you to log various types of communications between STRATOS and ENCOM radios. This feature is useful in diagnosing issues in radios that have been installed in the field. Note that logging should only be turned on when requested by ENCOM technical support personnel.

The logging function should be disabled as soon as it is no longer required. It can create very large files and can significantly reduce the performance of STRATOS.

The following screen shot shows the *Logging* panel of the *System Settings* form:



The following table describes the logging settings.

Logging options	
Field Name	**Description**
Enable	Check to enable logging of data sent between STRATOS and one or more radios.
Log file folder	Enter or select the folder in which the log files will be placed. The name of the log files that are created are of the form: yyyymmdd-hhmmss.log where:

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	yyyy is the year in which the log file was created mm is the month in which the log file was created dd is the day in which the log file was created hh is the hour at which the log file was created mm is the minute at which the log file was created ss is the second at which the log file was created A new log file is created whenever STRATOS is run.

Radio filtering	
Field Name	**Description**
MAC Address(es)	Enter the MAC address of the radio that you want to log. If you need to log the communication of more than one radio, enter the MAC address of each radio, separated with commas. If left blank, the communications for ALL radios is logged.

Interface options	
Field Name	**Description**
SSH command interface	Check to log SSH based communications.
API command interface	Check to log API based communications.
MAC Telnet interface	Check to log MAC Telnet based communications.
FTP transfers	Check to log the start and end of FTP file transfers. Note that the content of the files is not included in the log.

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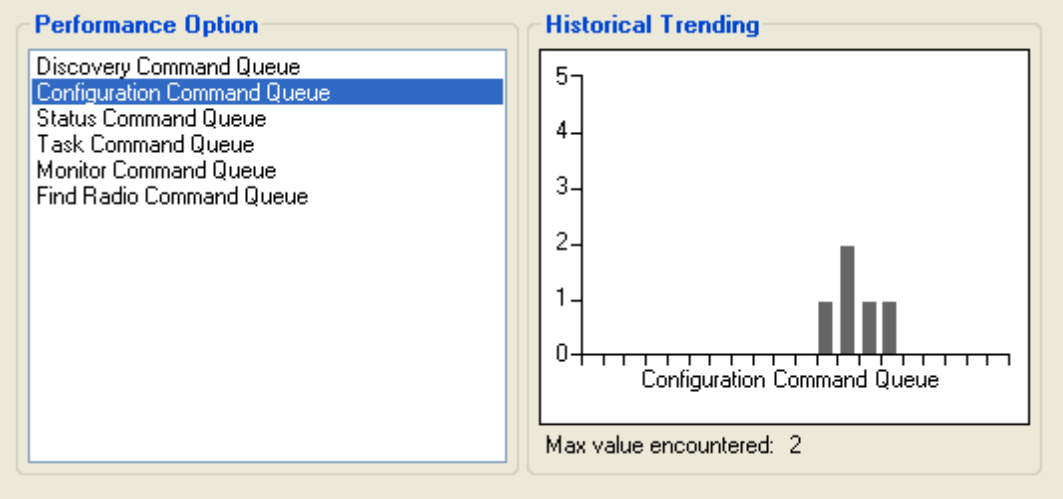
Status - Performance

The performance panel displays the current state of the various queues that are present in STRATOS. The information displayed can be of use to ENCOM technical support personnel when diagnosing STRATOS performance issues.

The following screen shot shows the *Performance* panel of the *System Settings* form:



To view the state of a particular queue, simply select it from the **Performance Option** list. The **Historical Trending** chart displays the number of commands currently in the queue.

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Help Menu Commands

Help Topics

Select **Help Topics** from the **Help** menu to display the ENCOM STRATOS on-line help.

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Licensing

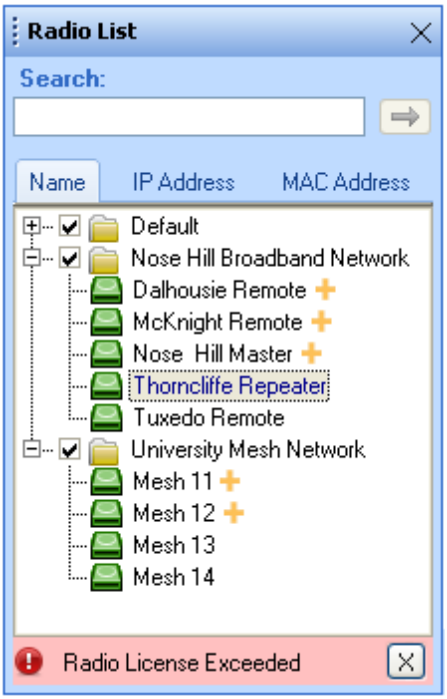
Select **Licensing...** from the **Help** menu to display the ENCOM STRATOS licensing form. This form allows you to request and install licenses that enable advanced monitoring features for a specific number of ENCOM radios.

The advanced features are:

- Display of wireless link lines on the map
- Display of radio status halos on the map
- Detection and notification of alarm conditions

A new installation of STRATOS supports advanced features for up to 5 radios. To support more than 5 radios, you need to purchase the appropriate license level, and activate the license using the licensing form.

If your network contains more radios than are supported by the current license, STRATOS will automatically choose the radios that will participate in the advanced monitoring functions. These radios are identified by a + symbol at the right of the radio's name in the Radio List panel. As well, a 'License Exceeded' indicator is displayed at the bottom of the panel to alert you to the situation.



Preference will be given to on-line radios. If an off-line radio was initially licensed, and STRATOS detects that an unlicensed radio has come on-line, the off-line radio's license is re-assigned to the on-line radio.

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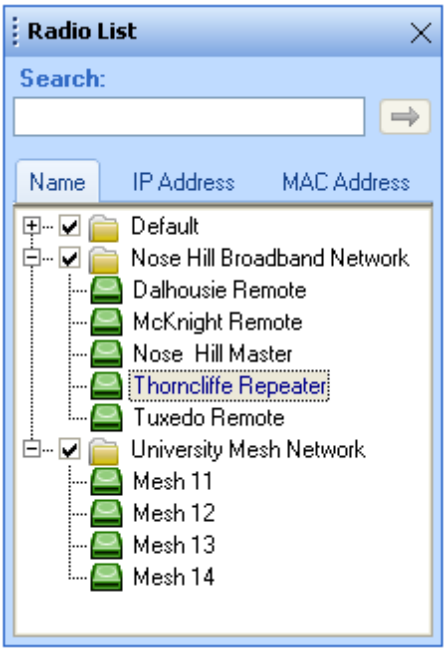
If you have acquired and activated a license that supports all of the radios in your network, the + symbols are no longer displayed in the radio list panel, and the 'License Exceeded' indicator is no longer displayed.



Refer to the following topics for more information on STRATOS licensing:

- Requesting a New License
- Activating a New License
- Performing a Manual Activation
- Requesting a License Upgrade
- Upgrading an Existing License
- Performing a Manual Upgrade

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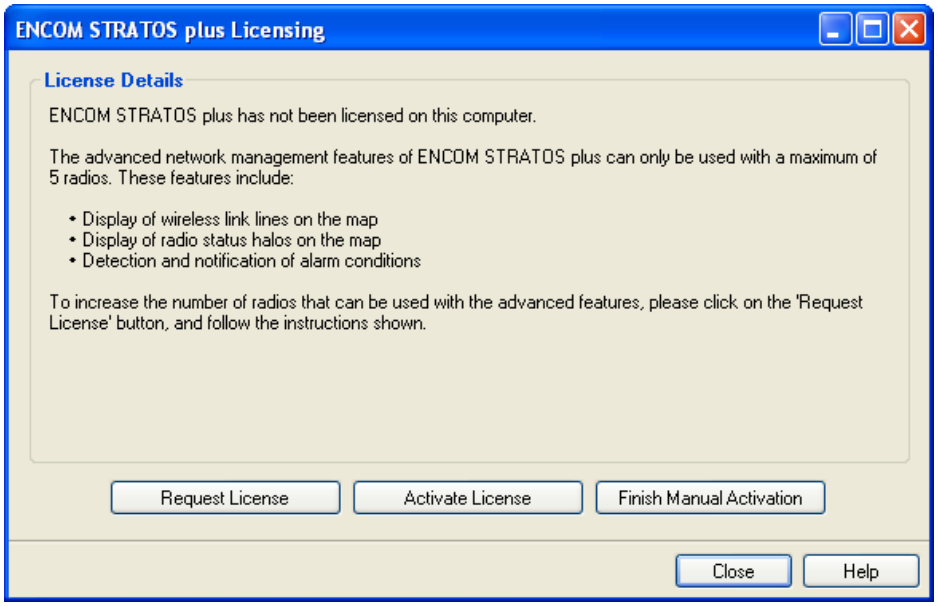
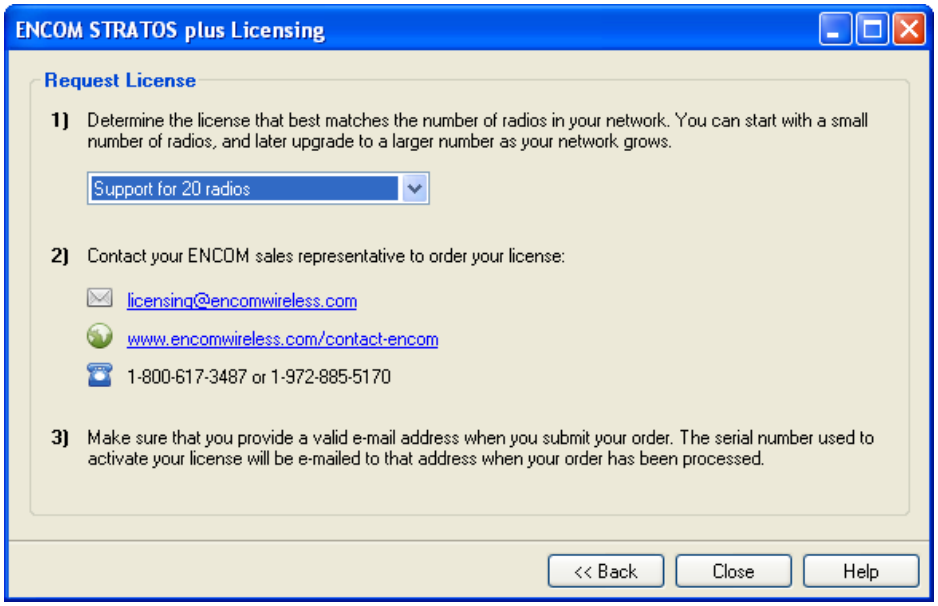
Requesting a New License

To request a license for a new installation of STRATOS:

1. Select **Licensing...** from the **Help** menu to display the ENCOM STRATOS licensing form:


ENCOM STRATOS plus Licensing
License Details
ENCOM STRATOS plus has not been licensed on this computer.
The advanced network management features of ENCOM STRATOS plus can only be used with a maximum of 5 radios. These features include:
• Display of wireless link lines on the map
• Display of radio status halos on the map
• Detection and notification of alarm conditions
To increase the number of radios that can be used with the advanced features, please click on the 'Request License' button, and follow the instructions shown.
Request License
Activate License
Finish Manual Activation
Close
Help

2. Click the **Request License** button. The *Request License* page is displayed:


ENCOM STRATOS plus Licensing
Request License
1) Determine the license that best matches the number of radios in your network. You can start with a small number of radios, and later upgrade to a larger number as your network grows.
Support for 20 radios
2) Contact your ENCOM sales representative to order your license:
licensing@encomwireless.com
www.encomwireless.com/contact-encom
1-800-617-3487 or 1-972-885-5170
3) Make sure that you provide a valid e-mail address when you submit your order. The serial number used to activate your license will be e-mailed to that address when your order has been processed.
<< Back
Close
Help

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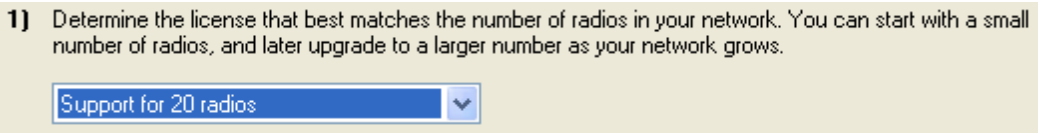
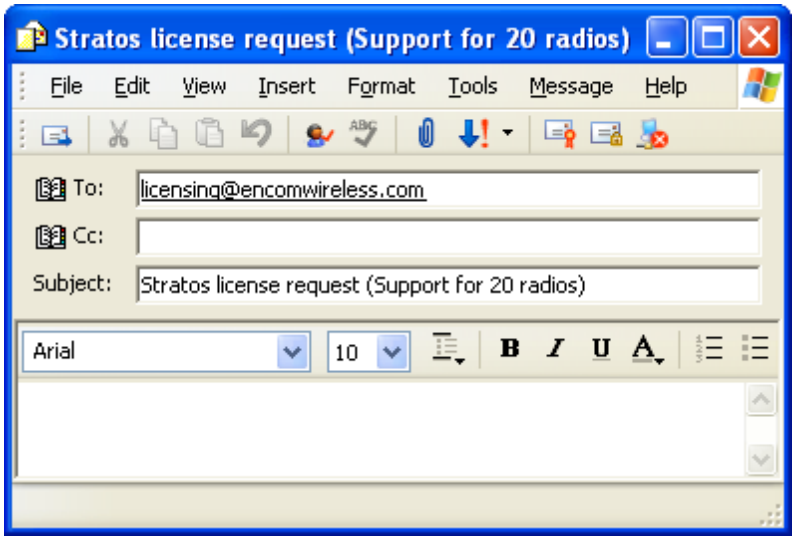
3. Select the license that supports the number of radios in your network. You can start with a small license, and upgrade to a larger license as you add more radios to your network.


1) Determine the license that best matches the number of radios in your network. You can start with a small number of radios, and later upgrade to a larger number as your network grows.
Support for 20 radios

4. Order your license from your ENCOM sales representative (or use the contact information shown in step 2).

   If an e-mail client is installed on your computer, click on the licensing@encomwireless.com link to create a pre-populated license request e-mail:


Stratos license request (Support for 20 radios)
File Edit View Insert Format Tools Message Help
To: licensing@encomwireless.com
Cc:
Subject: Stratos license request (Support for 20 radios)
Arial
10

   Please include the following information with your request:

   - Company name
   - Contact name
   - Contact email address
   - Purchase Order number (if you are using a purchase order)

5. When your request has been processed, an activation serial number will be sent to the email address that you specified in the request.

   Refer to the Activating a New License topic for instructions on activating your license.

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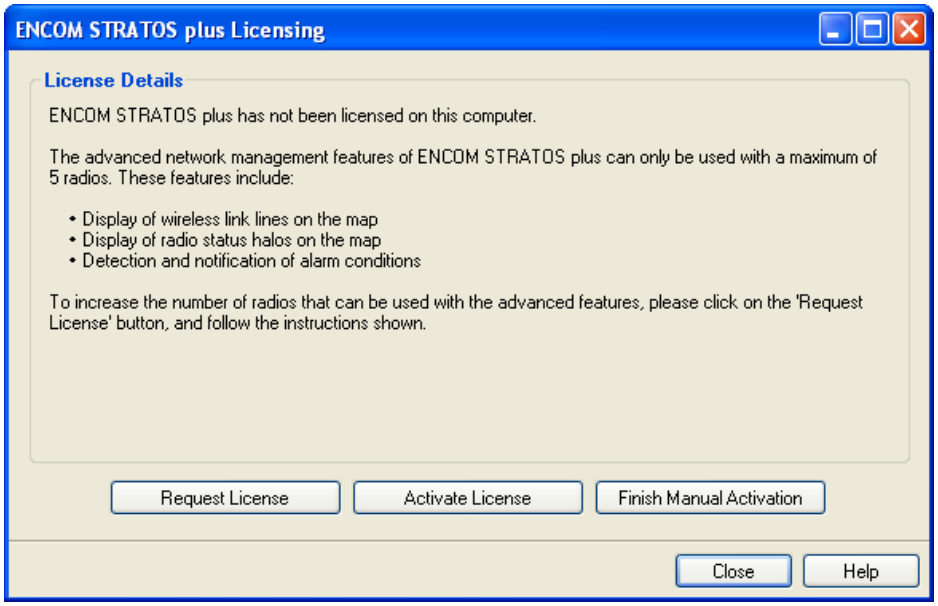
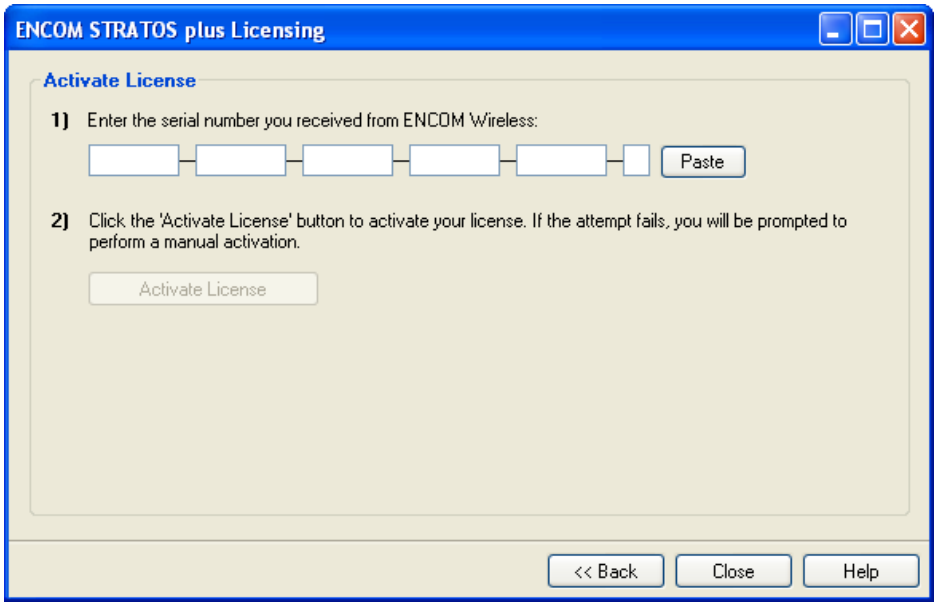
Activating a New License

To activate a new license:

1. Select **Licensing...** from the **Help** menu to display the ENCOM STRATOS licensing form:


ENCOM STRATOS plus Licensing
License Details
ENCOM STRATOS plus has not been licensed on this computer.
The advanced network management features of ENCOM STRATOS plus can only be used with a maximum of 5 radios. These features include:
• Display of wireless link lines on the map
• Display of radio status halos on the map
• Detection and notification of alarm conditions
To increase the number of radios that can be used with the advanced features, please click on the 'Request License' button, and follow the instructions shown.
Request License
Activate License
Finish Manual Activation
Close
Help

2. Click the **Activate License** button. The *Activate License* page is displayed:


ENCOM STRATOS plus Licensing
Activate License
1) Enter the serial number you received from ENCOM Wireless:
Paste
2) Click the 'Activate License' button to activate your license. If the attempt fails, you will be prompted to perform a manual activation.
Activate License
<< Back
Close
Help

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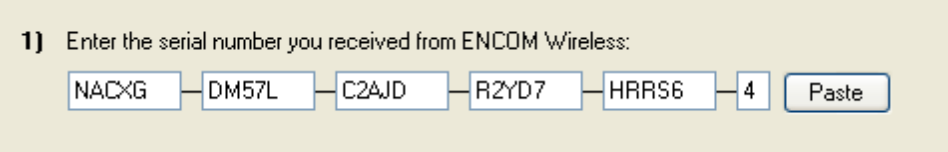
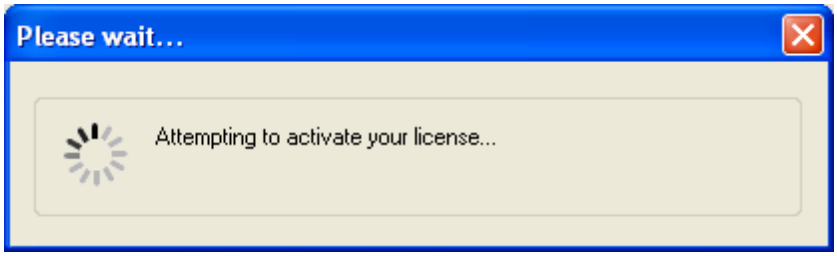
3. Enter the serial number you received from ENCOM in the serial number field. Alternatively, you can copy and paste the serial number from your email to the serial number field.



4. Click on the **Activate License** button to activate your license. STRATOS will attempt to contact the ENCOM licensing server to perform the activation:



5. If the activation was successful, a confirmation message will be displayed:

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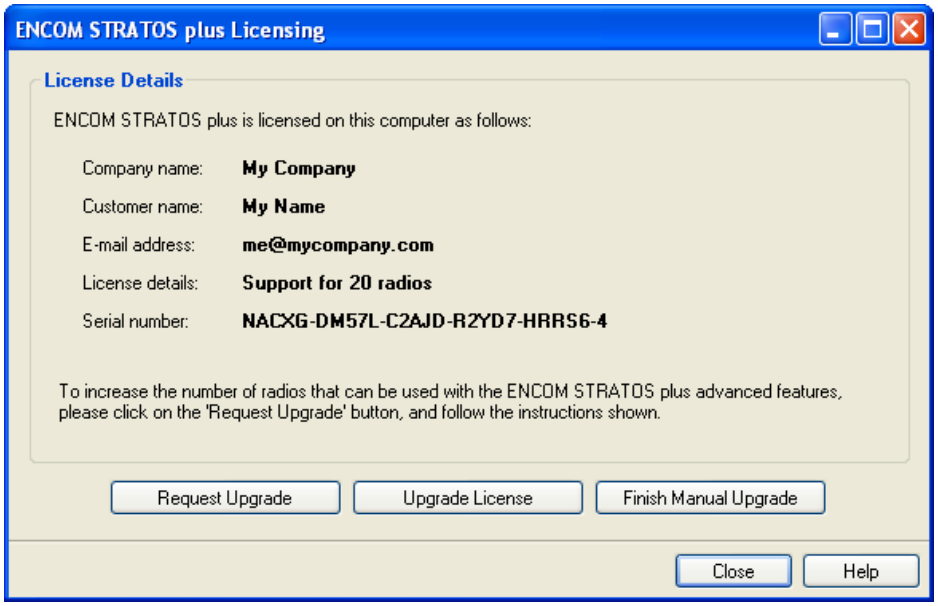
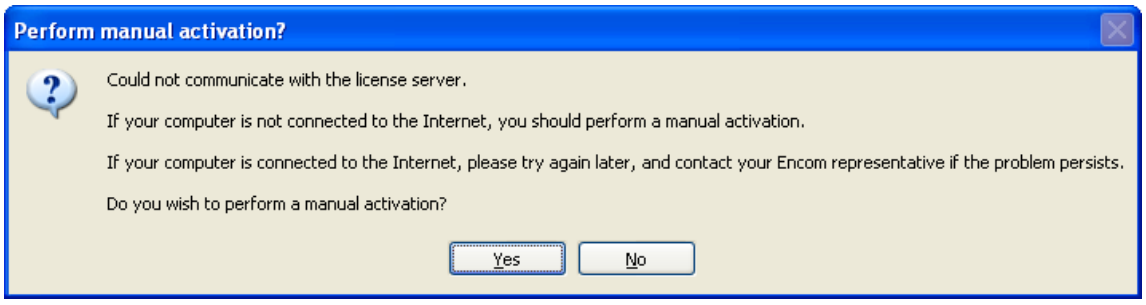
6. Click the **OK** button to return to the *License Details* page.


ENCOM STRATOS plus Licensing
License Details
ENCOM STRATOS plus is licensed on this computer as follows:
Company name: My Company
Customer name: My Name
E-mail address: me@mycompany.com
License details: Support for 20 radios
Serial number: NACXG-DM57L-C2AJD-R2YD7-HRRS6-4
To increase the number of radios that can be used with the ENCOM STRATOS plus advanced features, please click on the 'Request Upgrade' button, and follow the instructions shown.
Request Upgrade
Upgrade License
Finish Manual Upgrade
Close
Help

7. Click the **Close** button to return to STRATOS. The Radio List panel will be updated to reflect the new license.

8. If the activation was not successful, the following message will be displayed:


Perform manual activation?
Could not communicate with the license server.
If your computer is not connected to the Internet, you should perform a manual activation.
If your computer is connected to the Internet, please try again later, and contact your Encom representative if the problem persists.
Do you wish to perform a manual activation?
Yes
No

9. If the activation failed because your computer is not connected to the Internet, but you are able to temporarily connect it to the Internet, click on the **No** button to dismiss the message, connect your computer to the Internet, and then click on the **Activate License** button again. Contact your IT department if you need help connecting your computer to the Internet.

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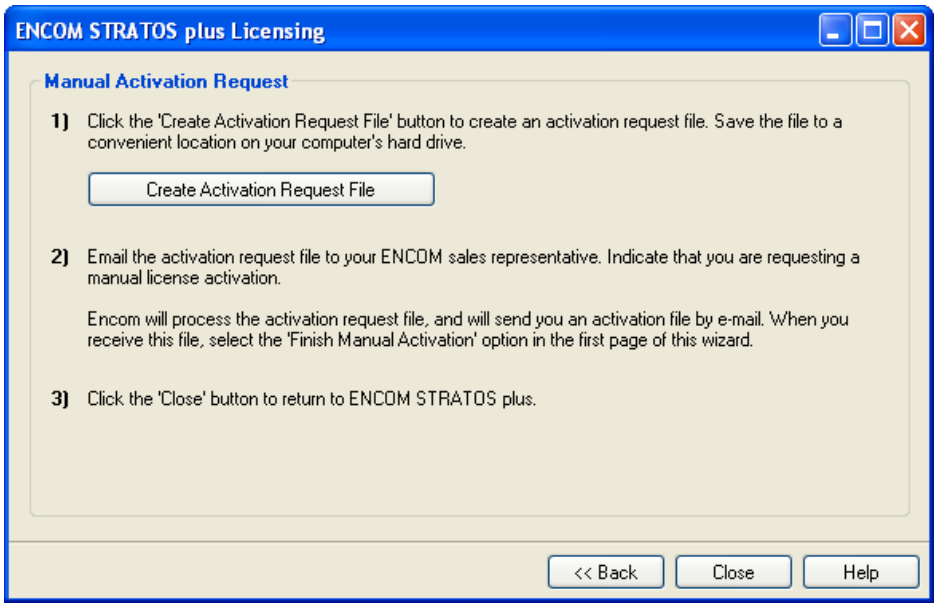
10. If the activation failed because your computer is not connected to the Internet, and you are not able to connect it to the Internet, you will need to perform a manual activation. Click the **Yes** button to proceed. The *Manual Activation Request* page is displayed:


ENCOM STRATOS plus Licensing
Manual Activation Request
1) Click the 'Create Activation Request File' button to create an activation request file. Save the file to a convenient location on your computer's hard drive.
Create Activation Request File
2) Email the activation request file to your ENCOM sales representative. Indicate that you are requesting a manual license activation.
Encom will process the activation request file, and will send you an activation file by e-mail. When you receive this file, select the 'Finish Manual Activation' option in the first page of this wizard.
3) Click the 'Close' button to return to ENCOM STRATOS plus.
<< Back
Close
Help

11. Click the **Create Activation Request File** button to create the request file.

12. Email the request file to your ENCOM sales representative for processing. Please include the following information with your request:
    - Company name
    - Contact name
    - Contact email address

13. When your request has been processed, a license activation file will be sent to the email address that you specified in the request.

    Refer to the Performing a Manual Activation topic for instructions on manually activating your license.

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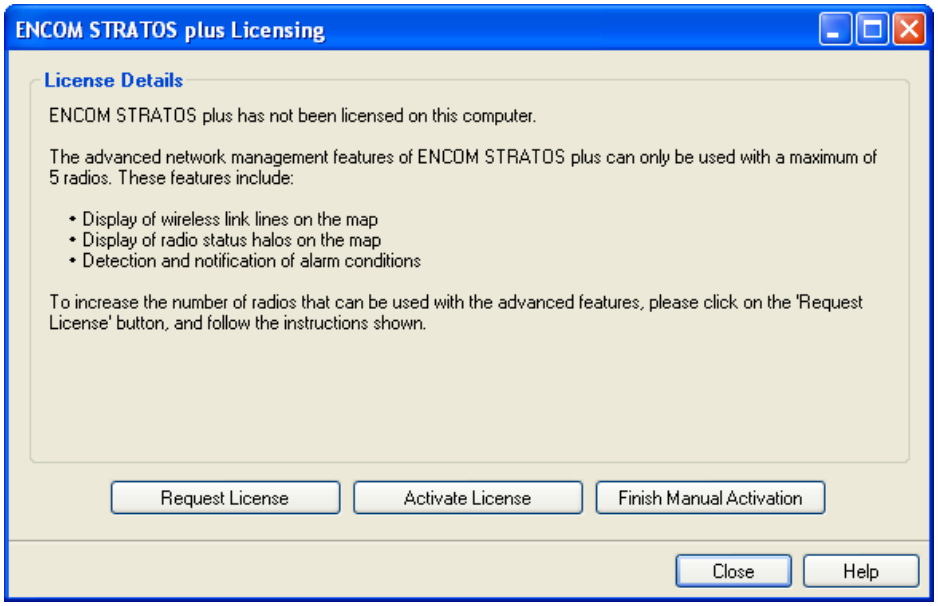
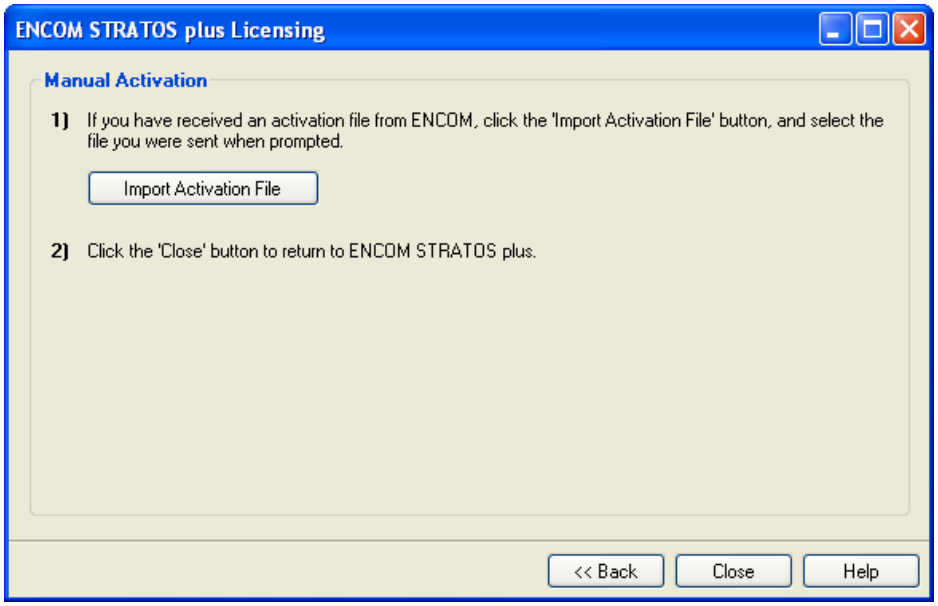
Performing a Manual Activation

To perform a manual license activation:

1. Select **Licensing...** from the **Help** menu to display the ENCOM STRATOS licensing form:


ENCOM STRATOS plus Licensing
License Details
ENCOM STRATOS plus has not been licensed on this computer.
The advanced network management features of ENCOM STRATOS plus can only be used with a maximum of 5 radios. These features include:
• Display of wireless link lines on the map
• Display of radio status halos on the map
• Detection and notification of alarm conditions
To increase the number of radios that can be used with the advanced features, please click on the 'Request License' button, and follow the instructions shown.
Request License
Activate License
Finish Manual Activation
Close
Help

2. Click the **Finish Manual Activation** button. The *Manual Activation* page is displayed:


ENCOM STRATOS plus Licensing
Manual Activation
1) If you have received an activation file from ENCOM, click the 'Import Activation File' button, and select the file you were sent when prompted.
Import Activation File
2) Click the 'Close' button to return to ENCOM STRATOS plus.
<< Back
Close
Help

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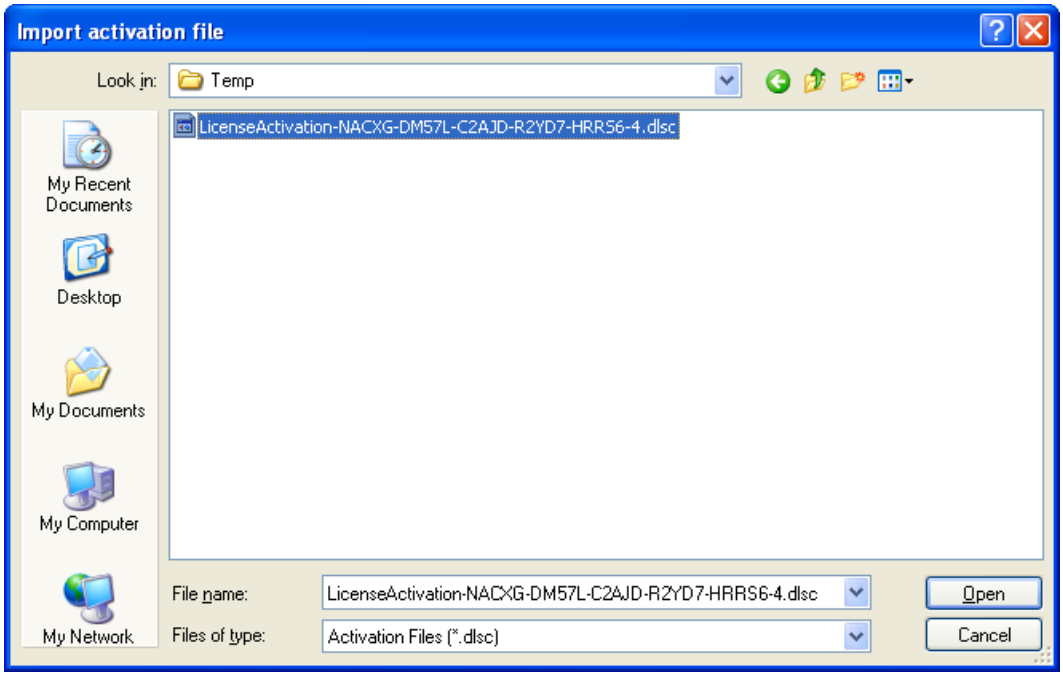
3. Click the **Import Activation File** button, and select the license activation file that you received from ENCOM when prompted:



4. If the activation was successful, a confirmation message will be displayed:

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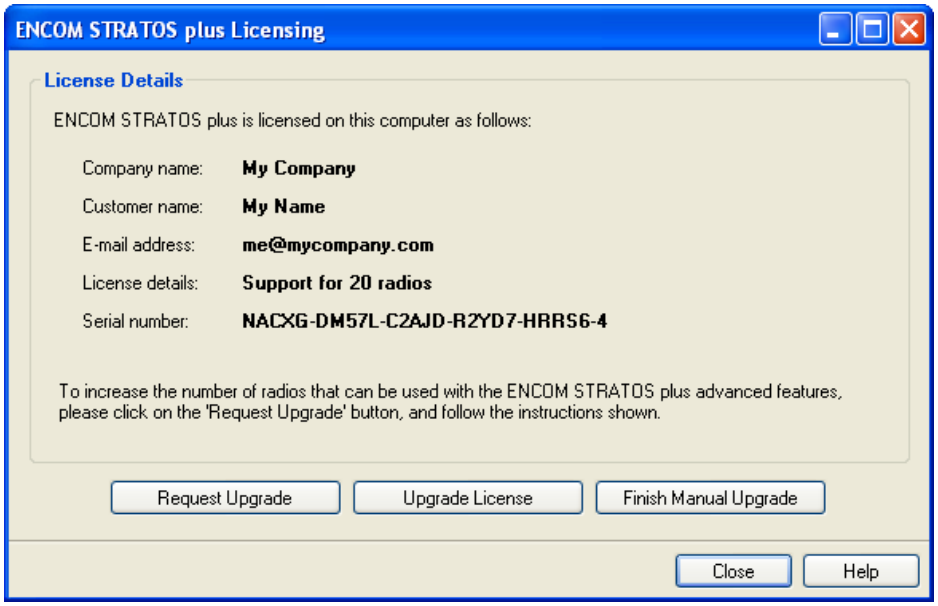
5. Click the **OK** button to return to the *License Details* page.


ENCOM STRATOS plus Licensing
License Details
ENCOM STRATOS plus is licensed on this computer as follows:
Company name: My Company
Customer name: My Name
E-mail address: me@mycompany.com
License details: Support for 20 radios
Serial number: NACXG-DM57L-C2AJD-R2YD7-HRRS6-4
To increase the number of radios that can be used with the ENCOM STRATOS plus advanced features, please click on the 'Request Upgrade' button, and follow the instructions shown.
Request Upgrade
Upgrade License
Finish Manual Upgrade
Close
Help

6. Click the **Close** button to return to STRATOS. The Radio List panel will be updated to reflect the new license.

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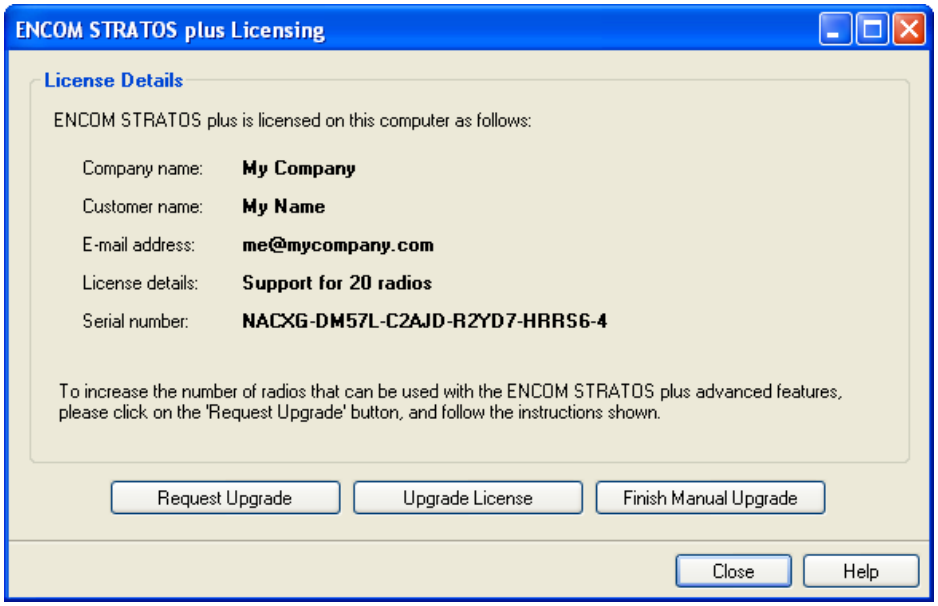
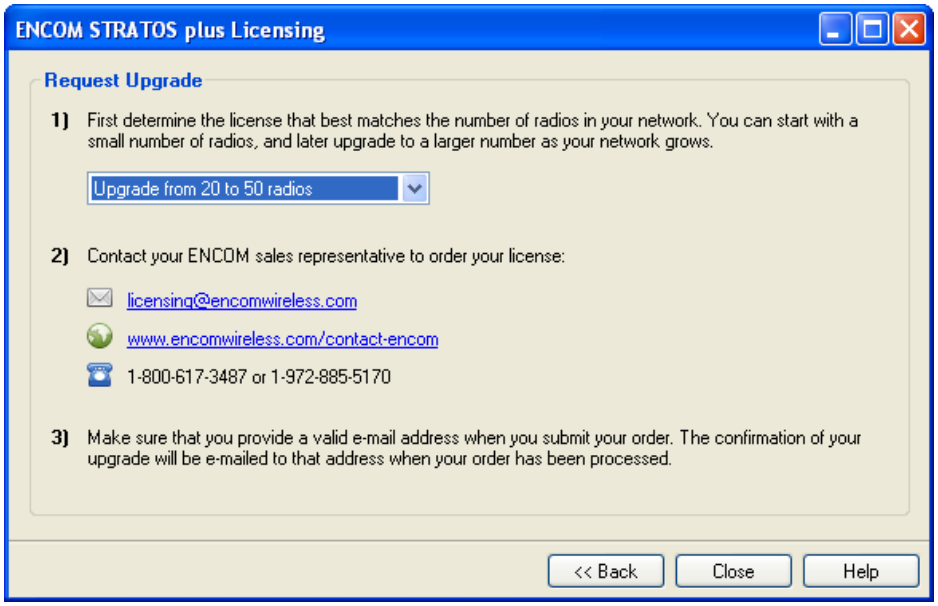
Requesting a License Upgrade

To request an upgrade for an installation of STRATOS that is already licensed:

1. Select **Licensing...** from the **Help** menu to display the ENCOM STRATOS licensing form:


ENCOM STRATOS plus Licensing
License Details
ENCOM STRATOS plus is licensed on this computer as follows:
Company name: My Company
Customer name: My Name
E-mail address: me@mycompany.com
License details: Support for 20 radios
Serial number: NACXG-DM57L-C2AJD-R2YD7-HRRS6-4
To increase the number of radios that can be used with the ENCOM STRATOS plus advanced features, please click on the 'Request Upgrade' button, and follow the instructions shown.
Request Upgrade
Upgrade License
Finish Manual Upgrade
Close
Help

2. Click the **Request Upgrade** button. The *Request Upgrade* page is displayed:


ENCOM STRATOS plus Licensing
Request Upgrade
1) First determine the license that best matches the number of radios in your network. You can start with a small number of radios, and later upgrade to a larger number as your network grows.
Upgrade from 20 to 50 radios
2) Contact your ENCOM sales representative to order your license:
licensing@encomwireless.com
www.encomwireless.com/contact-encom
1-800-617-3487 or 1-972-885-5170
3) Make sure that you provide a valid e-mail address when you submit your order. The confirmation of your upgrade will be e-mailed to that address when your order has been processed.
<< Back
Close
Help

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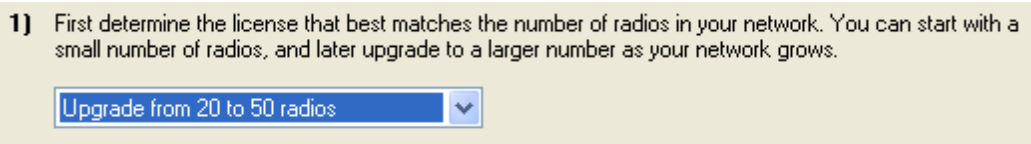
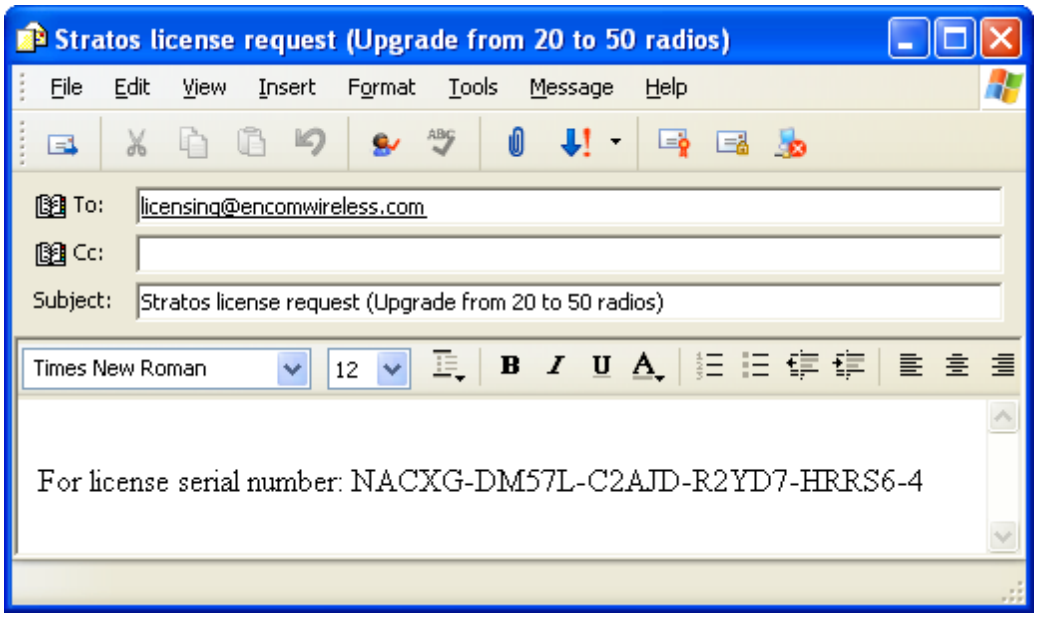
3. Select the license that supports the number of radios in your network.


1) First determine the license that best matches the number of radios in your network. You can start with a small number of radios, and later upgrade to a larger number as your network grows.
Upgrade from 20 to 50 radios

4. Order your license upgrade from your ENCOM sales representative (or use the contact information shown in step 2).

   If an e-mail client is installed on your computer, click on the licensing@encomwireless.com link to create a pre-populated upgrade request e-mail:


Stratos license request (Upgrade from 20 to 50 radios)
File Edit View Insert Format Tools Message Help
To: licensing@encomwireless.com
Cc:
Subject: Stratos license request (Upgrade from 20 to 50 radios)
Times New Roman 12
For license serial number: NACXG-DM57L-C2AJD-R2YD7-HRRS6-4

   Please include the following information with your request:

   - Company name
   - Contact name
   - Contact email address
   - Purchase Order number (if you are using a purchase order)

5. When your request has been processed, a confirmation of the upgrade will be sent to the email address that you specified in the request.

   Refer to the Upgrading an Existing License topic for instructions on upgrading your license.

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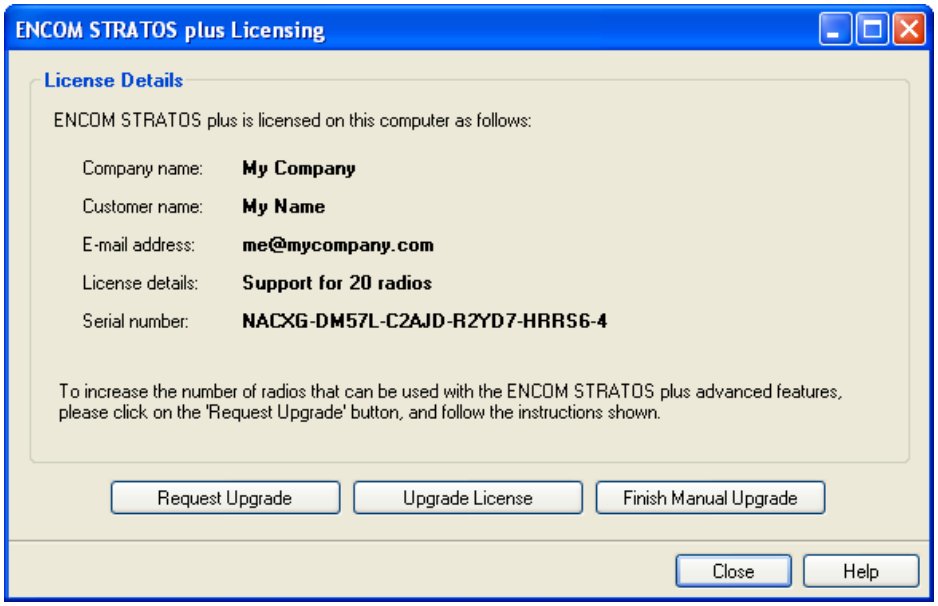
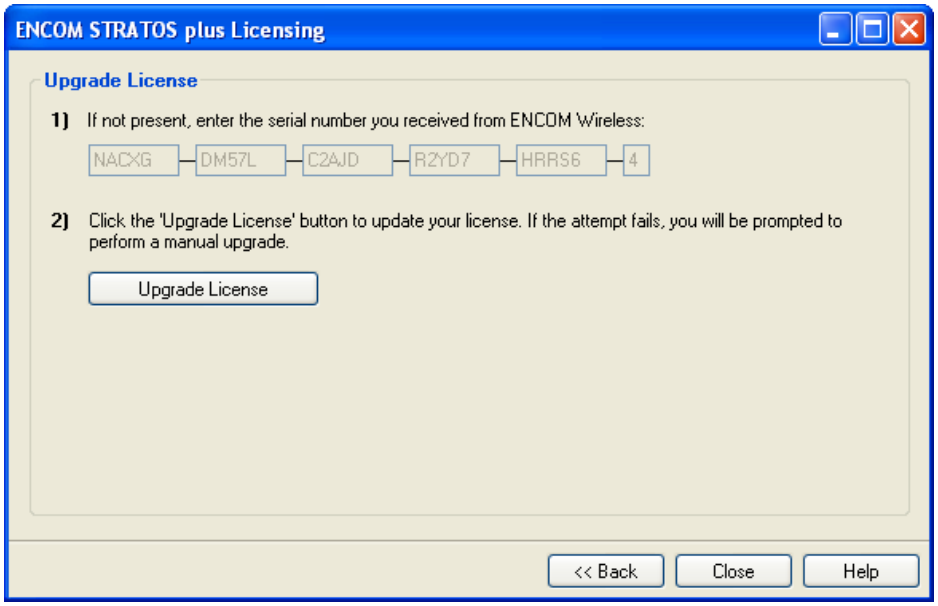
Upgrading an Existing License

To upgrade an existing license:

1. Select **Licensing...** from the **Help** menu to display the ENCOM STRATOS licensing form:


ENCOM STRATOS plus Licensing
License Details
ENCOM STRATOS plus is licensed on this computer as follows:
Company name: My Company
Customer name: My Name
E-mail address: me@mycompany.com
License details: Support for 20 radios
Serial number: NACXG-DM57L-C2AJD-R2YD7-HRRS6-4
To increase the number of radios that can be used with the ENCOM STRATOS plus advanced features, please click on the 'Request Upgrade' button, and follow the instructions shown.
Request Upgrade
Upgrade License
Finish Manual Upgrade
Close
Help

2. Click the **Upgrade License** button. The *Upgrade License* page is displayed:



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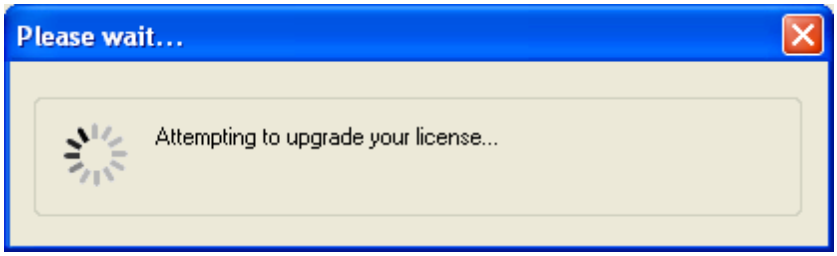
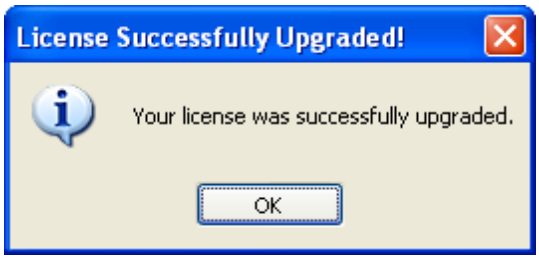
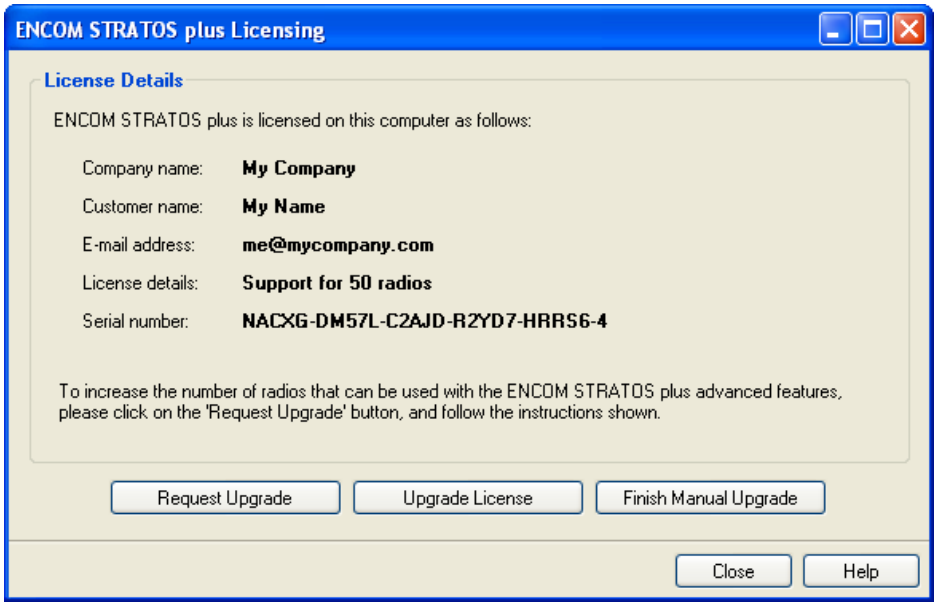
3. Click on the **Upgrade License** button to upgrade your license. STRATOS will attempt to contact the ENCOM licensing server to perform the upgrade:



4. If the upgrade was successful, a confirmation message will be displayed:



5. Click the **OK** button to return to the *License Details* page.


ENCOM STRATOS plus Licensing
License Details
ENCOM STRATOS plus is licensed on this computer as follows:
Company name: My Company
Customer name: My Name
E-mail address: me@mycompany.com
License details: Support for 50 radios
Serial number: NACXG-DM57L-C2AJD-R2YD7-HRRS6-4
To increase the number of radios that can be used with the ENCOM STRATOS plus advanced features, please click on the 'Request Upgrade' button, and follow the instructions shown.
Request Upgrade
Upgrade License
Finish Manual Upgrade
Close
Help

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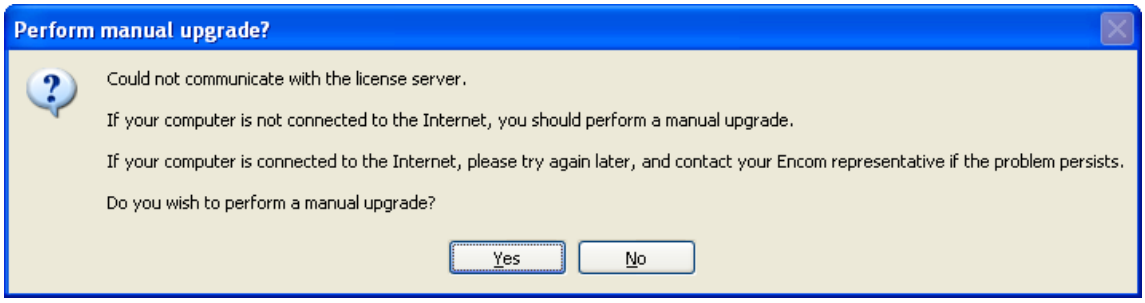
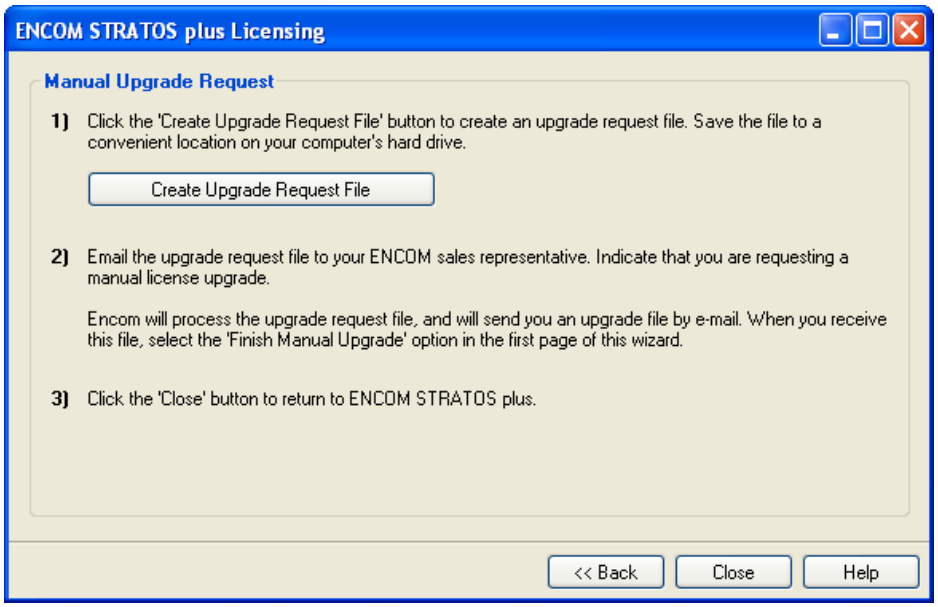
6. Click the **Close** button to return to STRATOS. The Radio List panel will be updated to reflect the new license.

7. If the upgrade was not successful, the following message will be displayed:


Perform manual upgrade?
Could not communicate with the license server.
If your computer is not connected to the Internet, you should perform a manual upgrade.
If your computer is connected to the Internet, please try again later, and contact your Encom representative if the problem persists.
Do you wish to perform a manual upgrade?
Yes
No

8. If the upgrade failed because your computer is not connected to the Internet, but you are able to temporarily connect it to the Internet, click on the **No** button to dismiss the message, connect your computer to the Internet, and then click on the **Upgrade License** button again. Contact your IT department if you need help connecting your computer to the Internet.

9. If the activation failed because your computer is not connected to the Internet, and you are not able to connect it to the Internet, you will need to perform a manual activation. Click the **Yes** button to proceed. The *Manual Upgrade Request* page is displayed:


ENCOM STRATOS plus Licensing
Manual Upgrade Request
1) Click the 'Create Upgrade Request File' button to create an upgrade request file. Save the file to a convenient location on your computer's hard drive.
Create Upgrade Request File
2) Email the upgrade request file to your ENCOM sales representative. Indicate that you are requesting a manual license upgrade.
Encom will process the upgrade request file, and will send you an upgrade file by e-mail. When you receive this file, select the 'Finish Manual Upgrade' option in the first page of this wizard.
3) Click the 'Close' button to return to ENCOM STRATOS plus.
<< Back
Close
Help

10. Click the **Create Upgrade Request File** button to create the request file.

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11. Email the request file to your ENCOM sales representative for processing. Please include the following information with your request:
    - Company name
    - Contact name
    - Contact email address

12. When your request has been processed, a license upgrade file will be sent to the email address that you specified in the request.

    Refer to the Performing a Manual Upgrade topic for instructions on manually upgrading your license.

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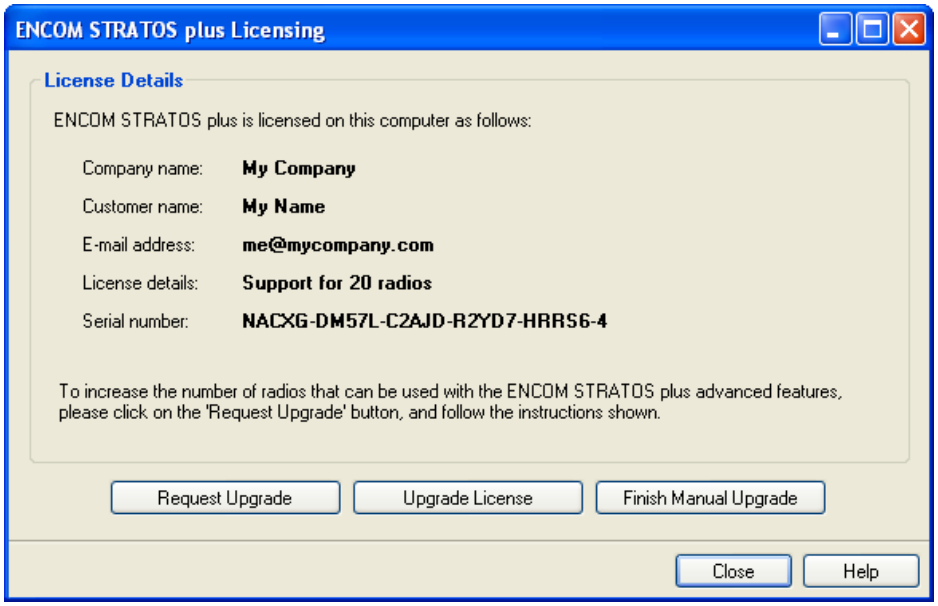
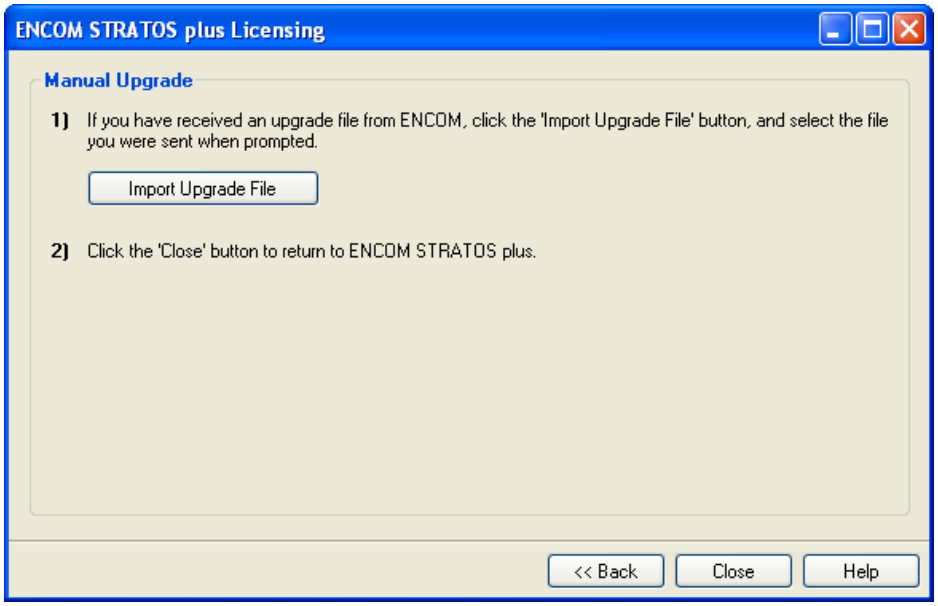
Performing a Manual Upgrade

To perform a manual license upgrade:

1. Select **Licensing...** from the **Help** menu to display the ENCOM STRATOS licensing form:


ENCOM STRATOS plus Licensing
License Details
ENCOM STRATOS plus is licensed on this computer as follows:
Company name: My Company
Customer name: My Name
E-mail address: me@mycompany.com
License details: Support for 20 radios
Serial number: NACXG-DM57L-C2AJD-R2YD7-HRRS6-4
To increase the number of radios that can be used with the ENCOM STRATOS plus advanced features, please click on the 'Request Upgrade' button, and follow the instructions shown.
Request Upgrade
Upgrade License
Finish Manual Upgrade
Close
Help

2. Click the **Finish Manual Upgrade** button. The *Manual Upgrade* page is displayed:


ENCOM STRATOS plus Licensing
Manual Upgrade
1) If you have received an upgrade file from ENCOM, click the 'Import Upgrade File' button, and select the file you were sent when prompted.
Import Upgrade File
2) Click the 'Close' button to return to ENCOM STRATOS plus.
<< Back
Close
Help

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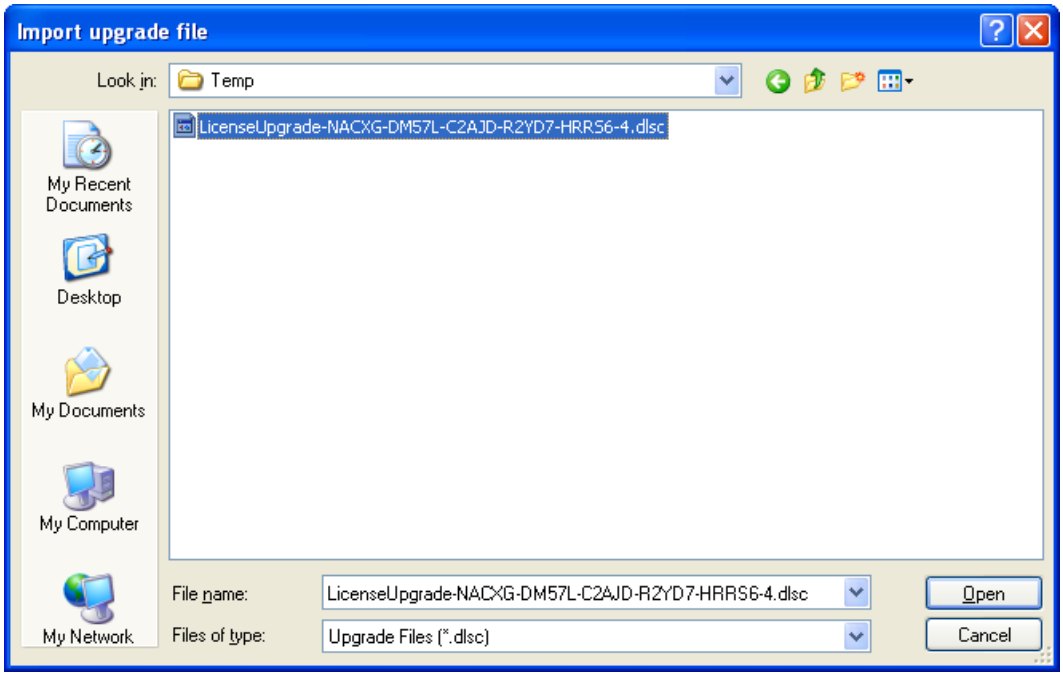
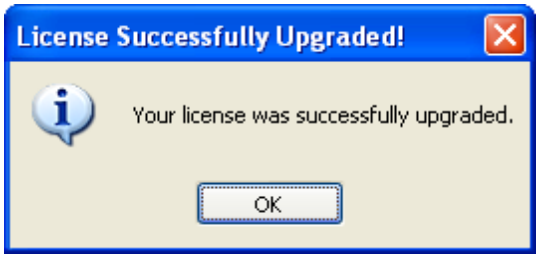
3. Click the **Import Upgrade File** button, and select the license upgrade file that you received from ENCOM when prompted:



4. If the upgrade was successful, a confirmation message will be displayed:



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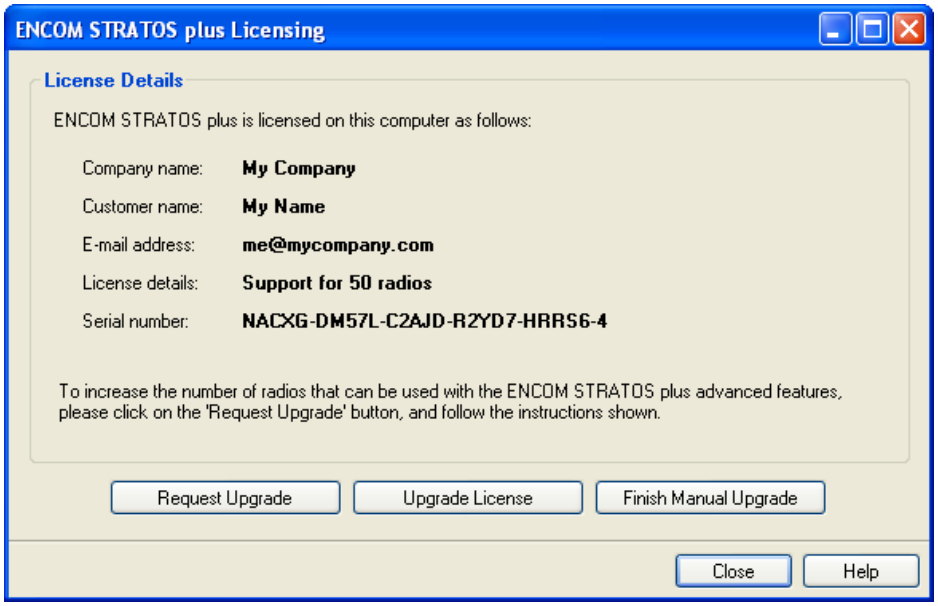
5. Click the **OK** button to return to the *License Details* page.


ENCOM STRATOS plus Licensing
License Details
ENCOM STRATOS plus is licensed on this computer as follows:
Company name: My Company
Customer name: My Name
E-mail address: me@mycompany.com
License details: Support for 50 radios
Serial number: NACXG-DM57L-C2AJD-R2YD7-HRRS6-4
To increase the number of radios that can be used with the ENCOM STRATOS plus advanced features, please click on the 'Request Upgrade' button, and follow the instructions shown.
Request Upgrade
Upgrade License
Finish Manual Upgrade
Close
Help

6. Click the **Close** button to return to STRATOS. The Radio List panel will be updated to reflect the new license.

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About...

Select **About...** from the **Help** menu to display information about ENCOM STRATOS.

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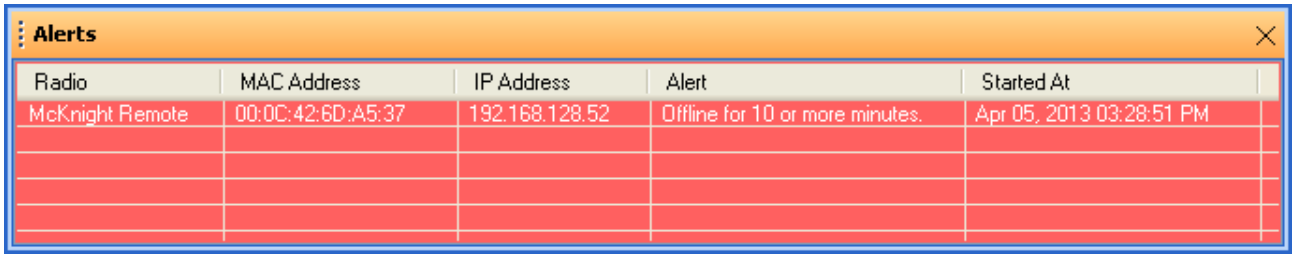
Panels

Alerts Panel

The *Alerts* panel displays alert messages that have been generated by STRATOS. It is normally hidden, and is automatically displayed when an alert is generated.

The background of the *Alerts* panel is normally white, but turns red when alerts are present.



The following table describes the information that is displayed for each alert shown in the list.

Column	Description
Radio	The name of the radio that caused the alert to be generated. If the alert is not associated with a particular radio, "<Not Applicable>" is displayed.
MAC Address	The radio's MAC address.
IP Address	The radio's IP address.
Alert	The condition that caused the alert to be generated.
Started At	The time at which the condition was detected.

Refer to the following topics for more information regarding the features of the *Ping Test* panel:

- Sorting the Alerts List
- Alerts Panel Context Menu

NOTE

Alerts are not stored in the STRATOS database. If STRATOS is shut down, all alerts shown in the panel will be lost.

If you want to keep a history of the alerts generated by STRATOS, you should define a recipient and set up a connection to an e-mail server. You can then keep records of the alerts using your email client.

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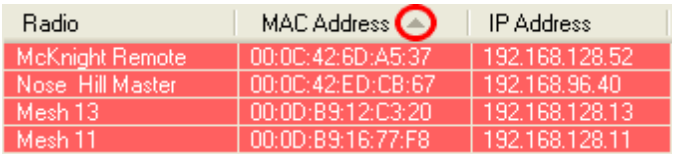
Sorting the Alerts List

You can sort the Alerts list by clicking the left mouse button on any of the table headers.

When you click on one of the headers, an arrow is displayed that indicates the direction of the sort.



Click once to sort in ascending order, and click again to sort in descending order.

Alerts Panel Context Menu

To display the *Alerts Panel* context menu, click the right mouse button anywhere on the *Alerts Panel* panel. The following context menu is displayed:

The following table describes the commands available in the context menu.

Command	Description
Select Radio	Selects the radio that is associated with the selected alert. This option is grayed out if an alert is not currently selected, or if more than one alert is currently selected. Alternatively, you can double-click the left mouse button on an alert to select the associated radio.
Remove Selected Alerts (Del)	Removes the selected alerts from the list. This option is grayed out if an alert is not currently selected.
Remove All Alerts	Remove all alerts from the list.

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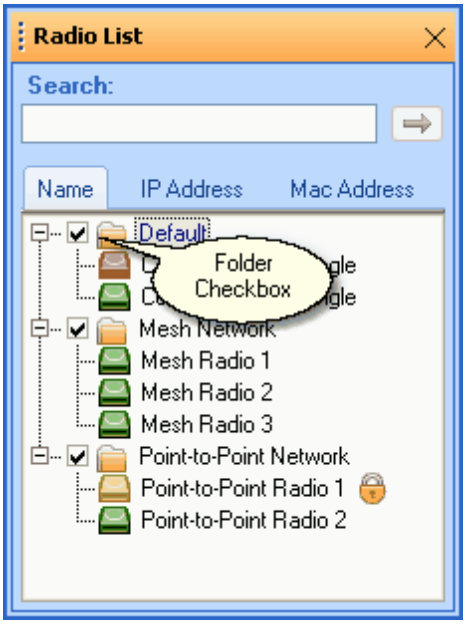
Radio List Panel

The *Radio List* panel contains the list of all radios known to ENCOM STRATOS. By default, it appears on the left-hand side of the STRATOS main window.



The radio list panel contains the following user interface items:

- Item search box
- Display type tabs
- Radio tree view

Refer to the following topics for more information regarding the features of the *Radio List* panel:

- Selecting Radios
- Moving Radios and Folders
- Setting the Location of a Radio
- Adding Radios to a Ping Test
- Showing and Hiding Radios on the Map
- Radio List Context Menu

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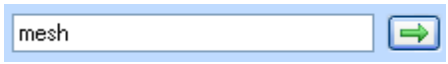
Item Search Box

The search box allows you to search the radio list based on a complete or partial match of the characters entered in the search box.

To use this feature:

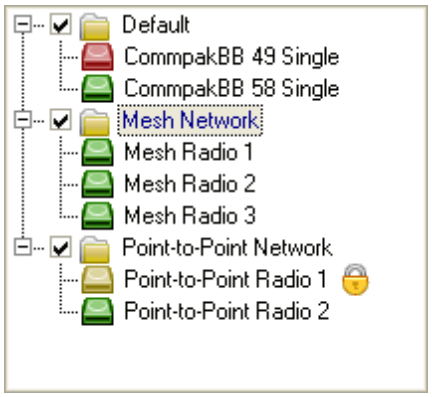
1. Enter the text you want to find in the search box, as shown in the following example:



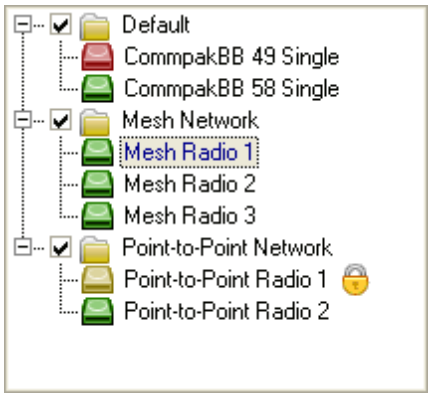
   The search is not case sensitive (searching for "mesh" or "MESH" will find the same items).

2. Click the button at the right of the search box, or press the **Enter** key on the keyboard, to perform the search.

3. The first item in the radio list that contains the search text will be selected, as shown in the following example:



4. Click the button, or press the **Enter** key, again to find the next matching item:



   If the last matching item is currently selected, the search will resume from the beginning of the list.

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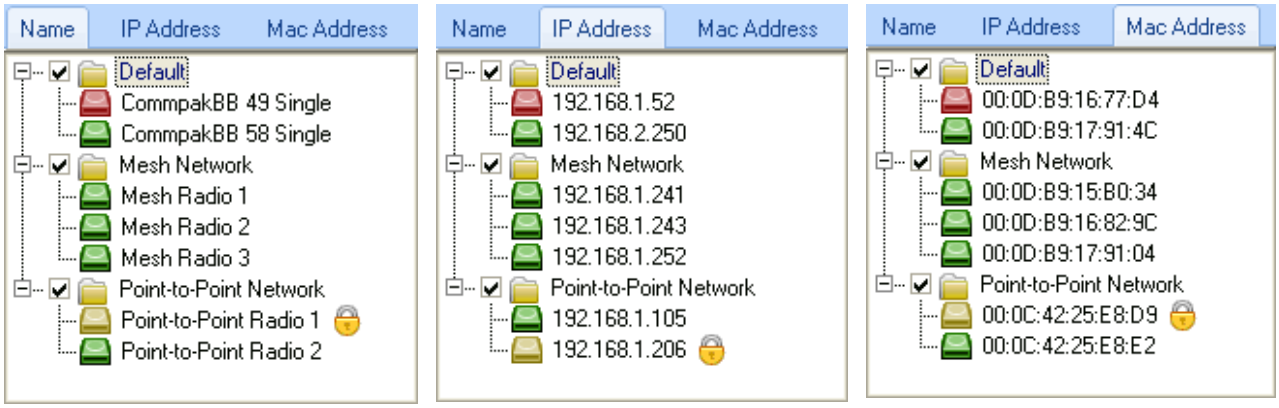
Display Type Tabs

The tabs at the top of the radio list allow you to display the radios in three formats: radio name, radio IP address and radio MAC address. Simply click on the appropriate tab to change the view.



Note: The radios are always sorted alphabetically within their parent folders.

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Radio Tree View

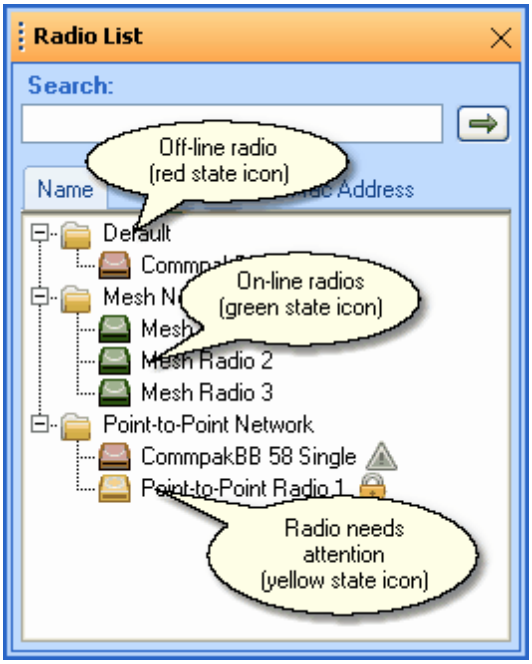
The radio tree view shows the radios that were discovered by ENCOM STRATOS, or that were manually added using the Add Radio and Find Radio functions.

Each radio item contains a state icon, the radio name, and a warning icon (displayed if the radio needs attention). If the **Show folder checkboxes** option in the User Interface tab of the System Settings form is checked, a checkbox is displayed next to the folder icons. This checkbox allows you to show or hide the radio icons in the map view panel.

The state icon, located at the left of the radio name, shows the current state of the radio. The color of the icon indicates one of three states:

Green	The radio is currently on-line.
Yellow	The radio is currently on-line, but needs attention. Place the mouse pointer over the warning icon to show more information.
Red	The radio is currently off-line.

The following screen shot shows examples of the state icons:



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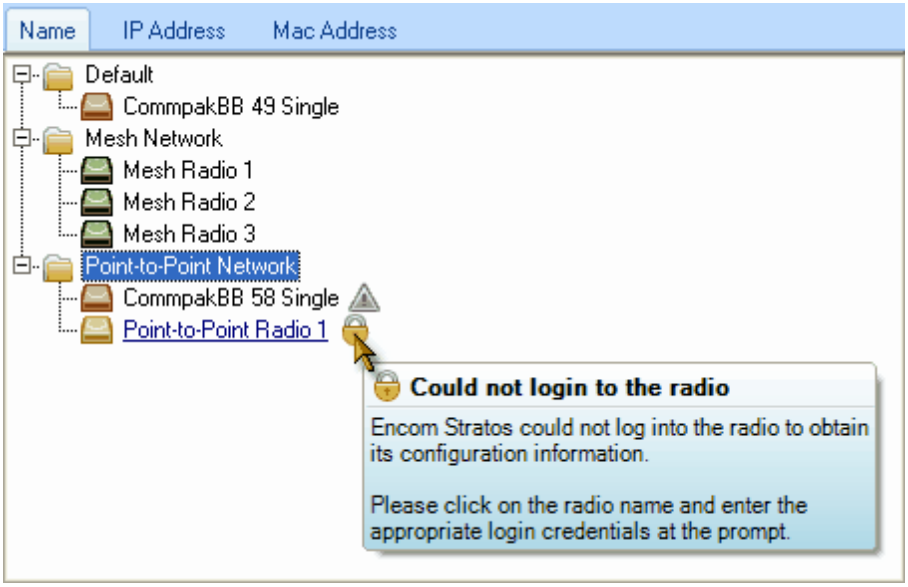
A warning icon, located at the right of the radio name, is displayed if the radio needs attention. To determine the action to take, move the mouse pointer over the warning icon. A pop-up help balloon will be displayed that explains the nature of the problem. The following example shows the warning for a radio that STRATOS is not able to log in to:


Name
IP Address
Mac Address
Default
CommpakBB 49 Single
Mesh Network
Mesh Radio 1
Mesh Radio 2
Mesh Radio 3
Point-to-Point Network
CommpakBB 58 Single
Point-to-Point Radio 1
Could not login to the radio
Encom Stratos could not log into the radio to obtain its configuration information.
Please click on the radio name and enter the appropriate login credentials at the prompt.

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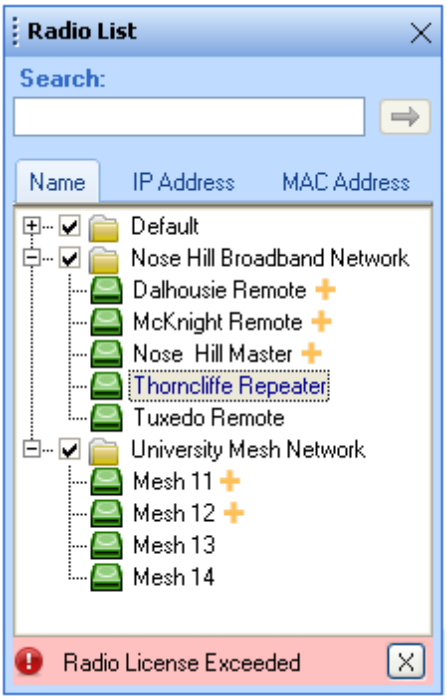
Version 2 of ENCOM STRATOS (also known as ENCOM STRATOS plus) introduces a number of advanced monitoring features that require licensing.

If your network contains more radios than are supported by the current license, STRATOS will automatically choose the radios that will participate in the advanced monitoring functions. These radios are identified by a + symbol at the right of the radio's name in the Radio List panel. As well, a 'License Exceeded' indicator is displayed at the bottom of the panel to alert you to the situation.



Please refer to the Licensing topic for more information on licensing the advanced monitoring features.

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Selecting Radios

The radio tree view allows you to select one or more radios using the mouse. Refer to the following topics for more information:

- Selecting Single Radios
- Selecting a Single Folder
- Selecting a Range of Radios
- Selecting Multiple Radios
- Selecting a Range of Folders
- Selecting Multiple Folders

Selecting Single Radios

To select a single radio, simply click the left mouse button on the radio name. The contents of the Map View panel, Item Properties panel, Wireless Link Status panel and Network Traffic panel are automatically update to reflect the newly selected radio.

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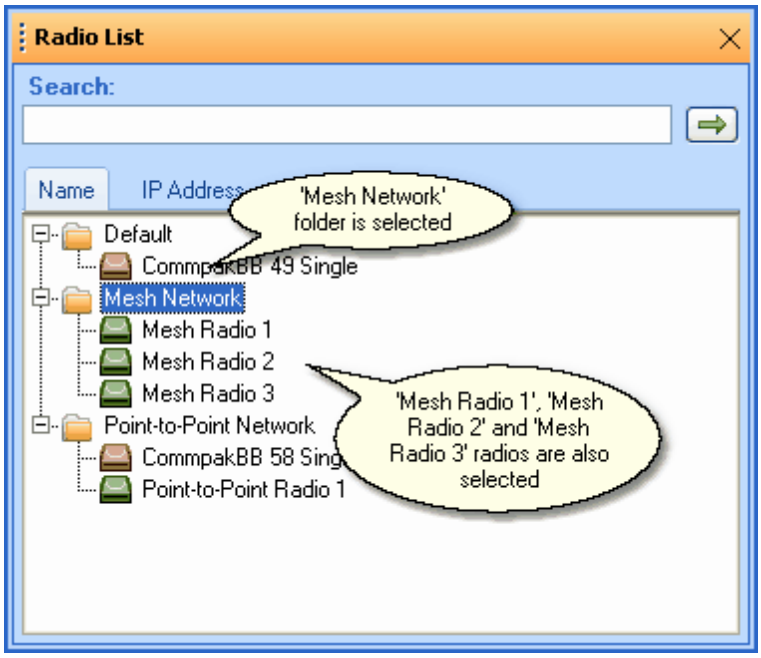
Selecting a Single Folder

To select a single folder, click the left mouse button on the folder name. The Wireless Link Status panel and Network Traffic panel are automatically disabled. The contents of the Item Properties panel are automatically updated to provide information on the newly selected folder.

Selecting a folder will automatically select all of the radios found in that folder, and in any sub-folders within the selected folder. This provides an easy way to select a group of radios to use with certain ENCOM STRATOS functions, such as the Ping Test.

In the following example, the **Mesh Network** folder has been selected, which implies that the **Mesh Radio 1**, **Mesh Radio 2** and **Mesh Radio 3** radios are also selected:



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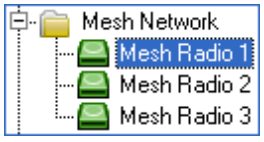
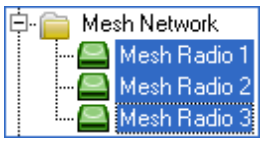
Selecting a Range of Radios

To select a range of radios, use the following procedure:

1. Click the left mouse button on the first radio in the range. The first radio will be highlighted.



2. Press and hold down the **Shift** key on the keyboard.
3. Click the left mouse button on the last radio in the range. All of the radios between the first radio and the last radio will be selected.

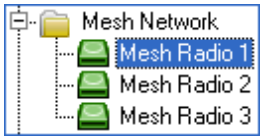


Note: All radios in the range must reside in the same folder in order for this technique to work.

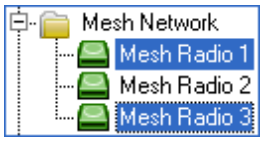
Selecting Multiple Radios

To select multiple radios, use the following procedure:

1. Click the left mouse button on the first radio. The radio will be highlighted.



2. Press and hold down the **Ctrl** key on the keyboard.
3. Click the left mouse button on each of the other radios to select. In the following example, the **Mesh Radio 1** and **Mesh Radio 3** radios were selected.



Note: All radios must reside in the same folder in order for this technique to work.

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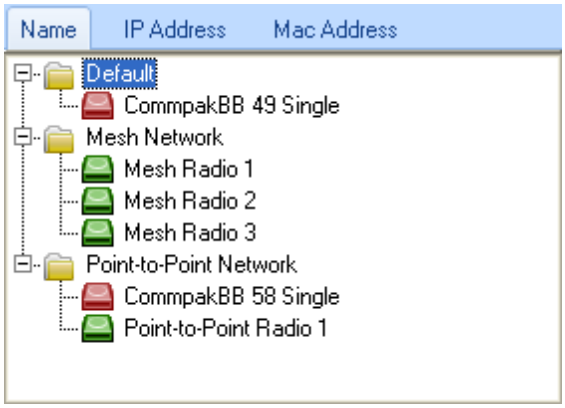
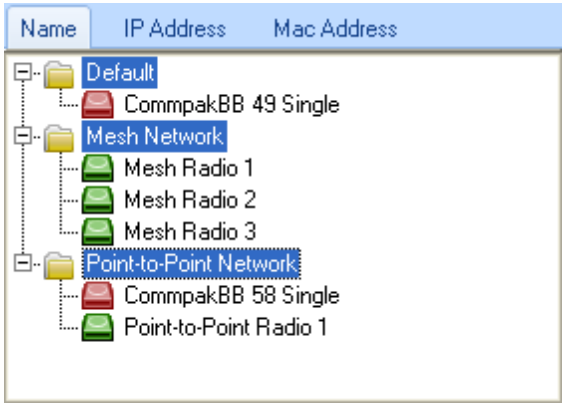
Selecting a Range of Folders

To select a range of folders, use the following procedure:

1. Click the left mouse button on the first folder in the range. The first folder will be highlighted.



2. Press and hold down the **Shift** key on the keyboard.
3. Click the left mouse button on the last folder in the range. All of the folders between the first folder and the last folder will be selected. By implication, all of the radios in the selected folders will also be selected.



Note: All folders in the range must reside in the same parent folder in order for this technique to work.

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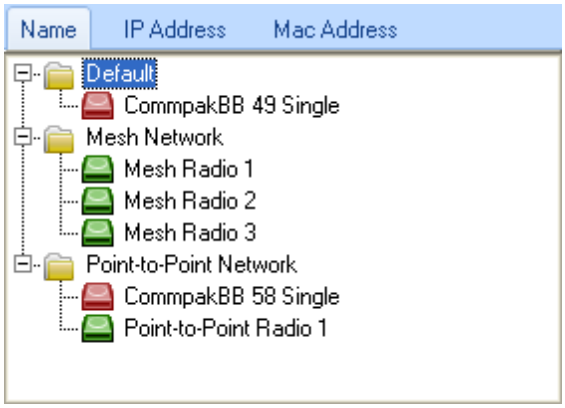
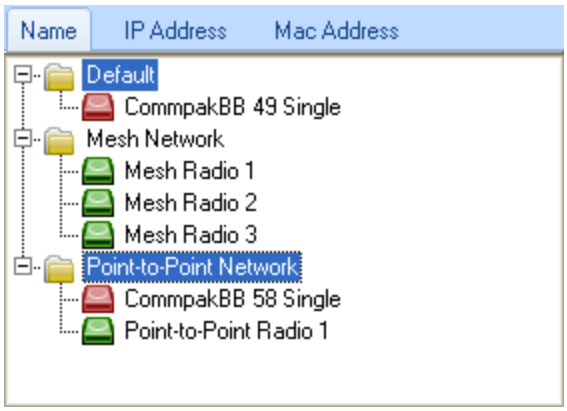
Selecting Multiple Folders

To select multiple folders, use the following procedure:

1. Click the left mouse button on the first folder. The folder will be highlighted.



2. Press and hold down the **Ctrl** key on the keyboard.
3. Click the left mouse button on each of the other folders to select. In the following example, the **Default** and **Point-to-Point Network** folders were selected. By implication, all of the radios in the selected folders will also be selected.



Note: All folders must reside in the same parent folder in order for this technique to work.

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Moving Radios and Folders

ENCOM STRATOS allows you to arrange the radios and folders in the radio list to suit your requirements. Refer to the following topics for more information:

- Moving a Single Radio or Folder
- Moving a group of Radios or Folders

Moving a Single Radio or Folder

To move a single radio or a single folder:

1. Click and hold the left mouse button on the item you want to move.
2. Drag the item to the folder to which to want to move the item.
3. Release the mouse button.
4. The item will be moved to the folder on which you released the mouse button.

Moving a group of Radios or Folders

To move a group of radios or folders:

1. Select a group of radios or a group of folders as described in the Selecting Radios topic.
2. Click and hold the left mouse button on one of the items you selected.
3. Drag the items to the folder to which to want to move them.
4. Release the mouse button.
5. The items will be moved to the folder on which you released the mouse button.

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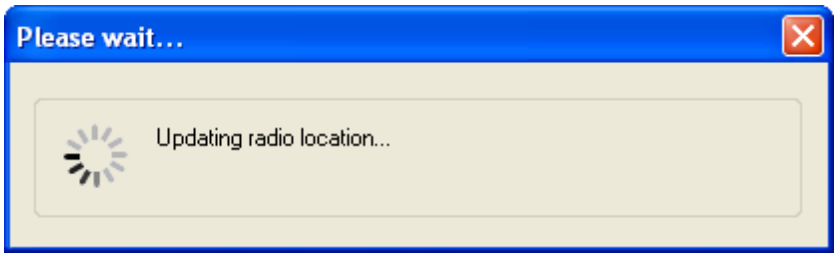
Setting the location of a radio

To set the location of a radio on the map:

1. Make sure that the Map View panel is visible.
2. Click and hold the left mouse button on the radio you want to locate.
3. Drag the radio to the desired location on the map. When dragging over the map, the drag cursor will show the icon currently associated with the device.

4. Release the mouse button to locate the radio on the map. The radio's latitude and longitude are set to the pointed end of the radio icon.

5. The radio's configuration settings will be updated with the new location.



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NOTE Because the radio's location is stored in the radio's configuration settings, it must be on-line in order for its location to be set.

NOTE You can only set the location of one radio at a time. Dragging two or more radios to the map will not work.

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Adding Radios to a Ping Test

To add radios to a ping test:

1. Select one or more radios, or one of more folders, in the Radio List panel. For information on selecting multiple radios or folders, refer to the Selecting Radios topic.
2. Select **Add to Ping Test** from the radio list context menu.
3. The Ping Test panel will be activated and shown if it was hidden.
4. The radios that were selected, or that are found in the folders that were selected, will be added to the *Ping Test* panel.
5. The ping test will automatically start if it is not already running.

Alternatively:

1. Make sure that the Ping Test panel is visible.
2. Select one or more radios, or one of more folders, in the Radio List panel. For information on selecting multiple radios or folders, refer to the Selecting Radios topic.
3. Click and hold the left mouse button on one of the items you selected.
4. Drag the items to the Ping Test panel.
5. Release the mouse button.
6. The radios that were selected, or that are found in the folders that were selected, will be added to the *Ping Test* panel.
7. The ping test will automatically start if it is not already running.

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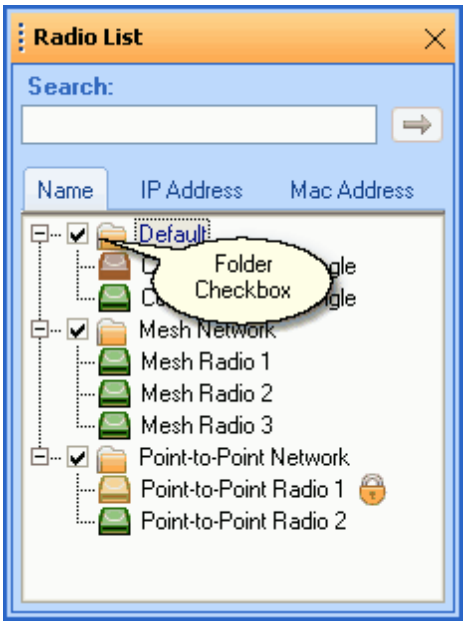
Showing and Hiding Radios on the Map

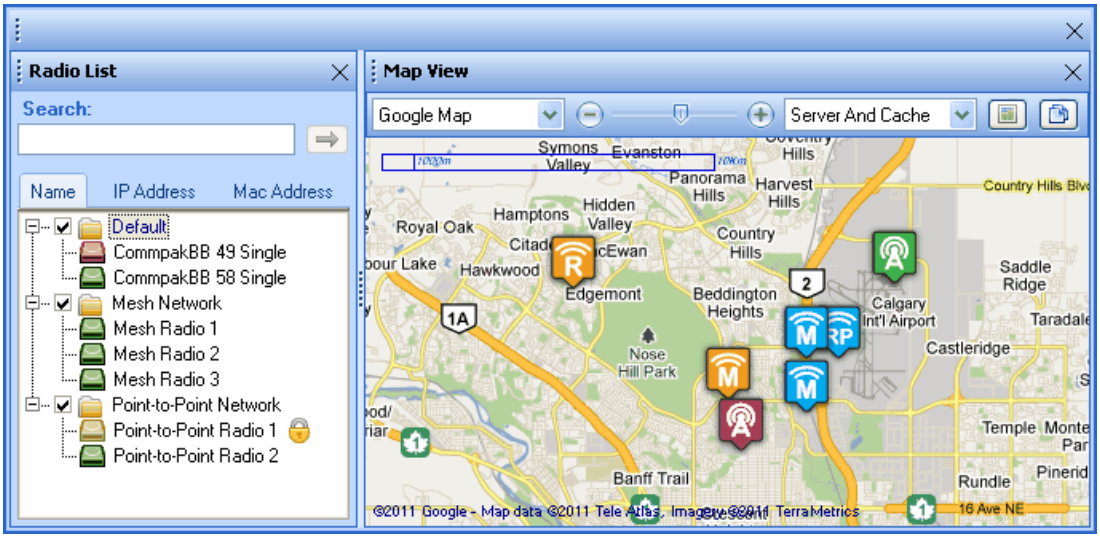
If your network contains a large number of radios, you may find that the map display becomes very crowded. ENCOM STRATOS helps you address this problem by allowing you to selectively display groups of radios.

To enable this feature, check the **Show folder checkboxes** option in the User Interface tab of the System Settings form.

When enabled, checkboxes will be displayed at the left of each folder in the radio list, as shown in the following example:



In the following example, all of the folders are checked, and all of the radio icons are shown in the map:



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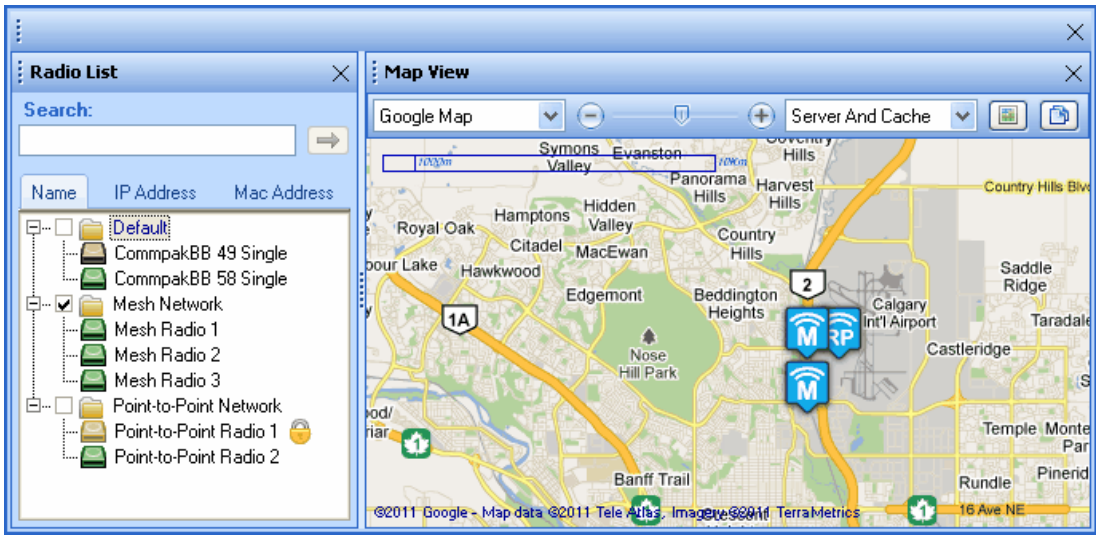
In the following example, the **Default** and **Point-to-Point Network** folders are unchecked. Only the icons for the radios in the **Mesh Network** folder are shown in the map:



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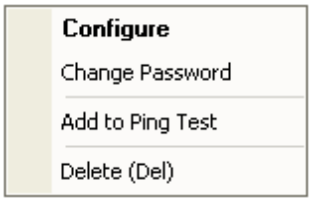
Radio List Context Menu

To display the radio list context menu, click the right mouse button anywhere inside of the radio tree view. Depending on where you click, the appropriate menu will be displayed.

If you click on a folder, the following context menu is displayed:	
If you click on a radio, the following context menu is displayed:	
If you click on empty space, the following context menu is displayed:	

The context menu provides a convenient way to access functions that are already available in the main menu bar.

For more information on the individual context menu items, click the left mouse button on the menu item text in the screenshots shown above.

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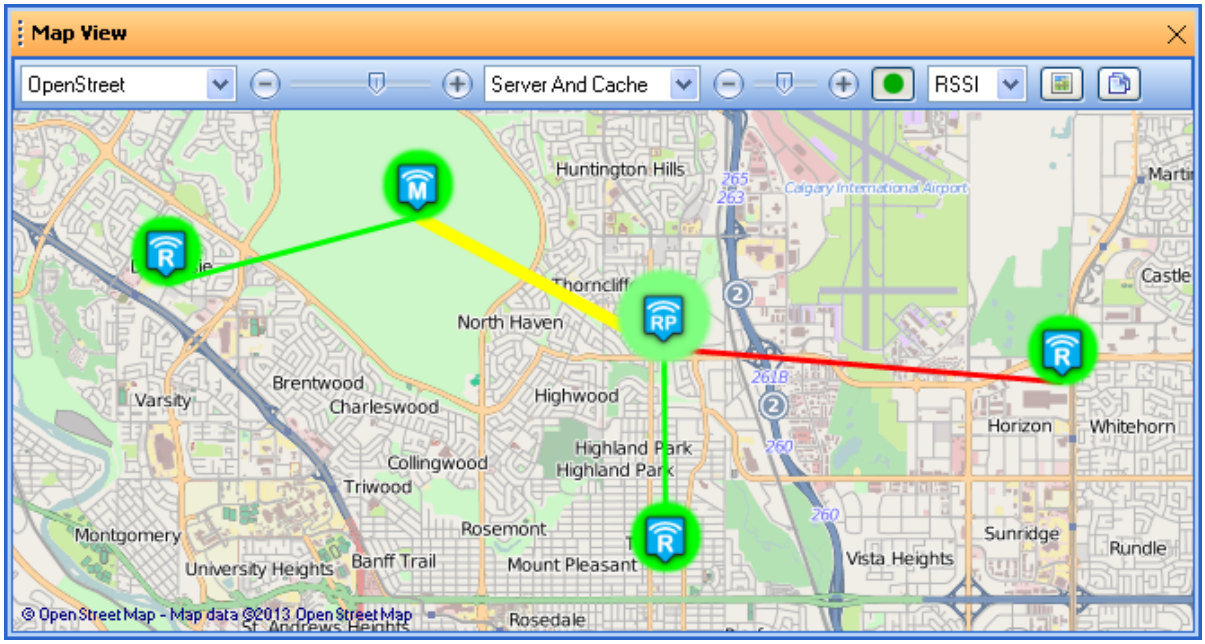
Map View Panel

The *Map View* panel allows you to see the location of your radios on a map. A typical map display, showing the location of five radios, is shown below.



The map panel contains two user interface elements:

- Map Toolbar
- Map Display

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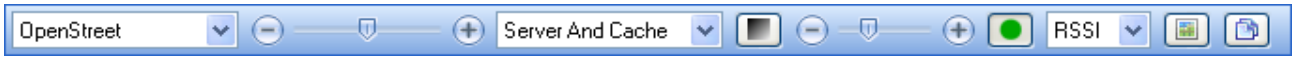
Map Toolbar

The map toolbar allows you to control the look and behavior of the map.



The following table describes the options and controls found in the map toolbar:

Field Name	Description
Map Provider	The left-hand drop down list box allows you to choose the map provider and the map style. In addition to regular road maps, several map providers support satellite image-based maps. These are useful at spotting landmarks that can help you locate or find a radio.
Zoom Bar	The zoom bar allows you to zoom the map display in or out. With the zoom bar, you can: • Use the (-) button to zoom out. • Use the (+) button to zoom in. • Use the slider to zoom in or out. Alternatively, click the left mouse pointer on the map to select it, and then use the mouse wheel to zoom in or out.
Caching Mode	The map display consists of a number of image tiles that are downloaded from the map provider and displayed on your computer. The caching mode determines how the map tiles are used by your computer. Three caching modes are available: 1. **Server Only:** No caching is performed. The map tiles are always requested from the server. This option is typically slower than the other options, and is not usually recommended. 2. **Server and Cache:** The map tiles will be downloaded from the map provider and stored on your computer. If present, stored tiles are used to render the map. New tiles are requested from the server as required. This option should be used if your computer is normally connected to the internet. 3. **Cache Only:** Only the stored tiles are used to render the map. This option is recommended for computers that don't have access to the Internet.

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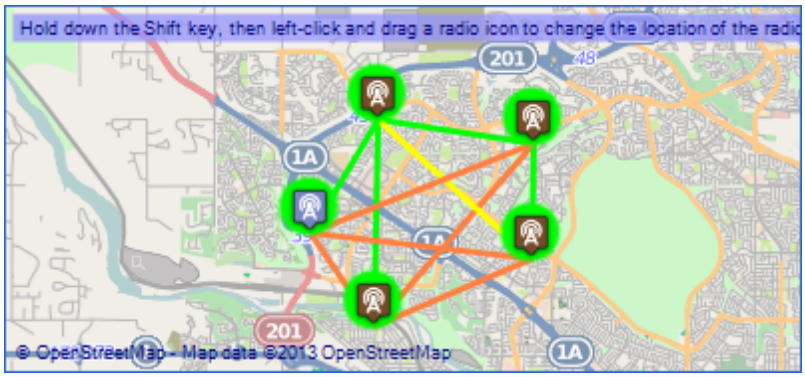
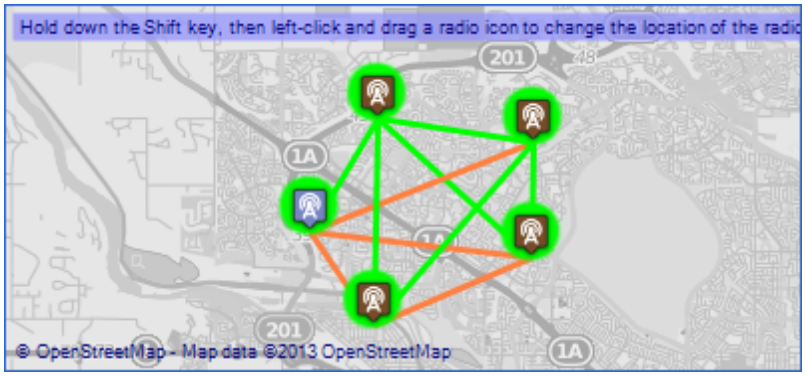
Grayscale	Click the **Grayscale** button to toggle the map between color and grayscale modes. Setting the map to grayscale can make it easier to discern the radio state indicators and the wireless link lines.  Hold down the Shift key, then left-click and drag a radio icon to change the location of the radio 201 1A © OpenStreetMap - Map data ©2013 OpenStreetMap  Hold down the Shift key, then left-click and drag a radio icon to change the location of the radio 201 1A © OpenStreetMap - Map data ©2013 OpenStreetMap
Icon Size	The icon size bar allows you to change the size of the icons displayed on the map. With the icon size bar, you can: • Use the (-) button to decrease the size of the icons. • Use the (+) button to increase the size of the icons. • Use the slider to change the icon sizes.
Radio State	Click the **Radio State** button to show or hide the map radio state indicators. The radio state indicators are displayed as a colored circle behind the radio icons. The color of the indicators match the color of the state indicators in the Radio List panel. In the following example, the radio state indicators show that two radios are on-line (green), and one is off-line (red):

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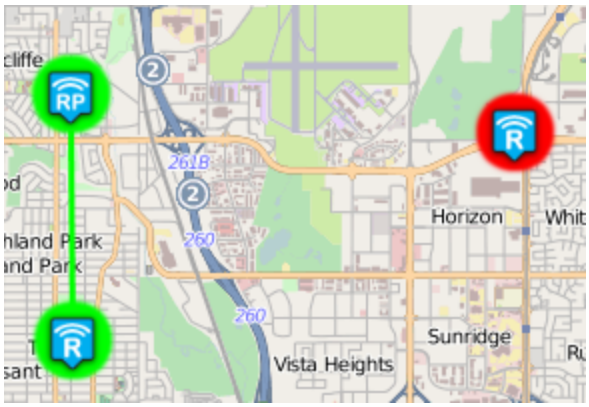

Note: The radio state indicators are only displayed for radios that are licensed. See the Licensing topic for more information on obtaining a license for your radio network.

Link Type

The **Link Type** drop down list box allows you to specify the nature of the wireless links shown between the radios.

One of the following options can be chosen:

Link Type	Description
None	No lines are displayed on the map.
RSSI	The lines represent the RSSI (signal strength) of the wireless links between the radios. The color of the line represents the worst of the receive or transmit signal strengths. For example, if the the receive signal strength is good, but the transmit signal strength is poor, the line color will represent the poor signal strength. The color of the lines are set in the RSSI Thesholds panel of the System Settings form.
CCQ	The lines represent the CCQ (signal quality) of the wireless links between the radios. The color of the line represents the worst of the receive or transmit signal quality. For example, if the the receive signal quality is good, but the transmit signal quality is poor, the line color will represent the poor signal quality.

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	<table><tr><td></td><td>The color of the lines are set in the CCQ Thesholds panel of the System Settings form.</td></tr></table> **Note:** The wireless link lines are only displayed for radios that are licensed. See the Licensing topic for more information on obtaining a license for your radio network
 Zoom All Button	Click on the **Zoom All** button to show all of the radios in the map display. This function will automatically zoom and re-center the map so that all of the radios are visible on the map. **Note:** If the Show folder checkboxes option in the System Settings form is checked, only those radios associated with the folders that are checked will be shown on the map.
 Copy to Clipboard Button	Click on the **Copy to Clipboard** button to copy the current map view to the Windows clipboard. You can then paste this copy into most Windows applications that support embedded pictures.

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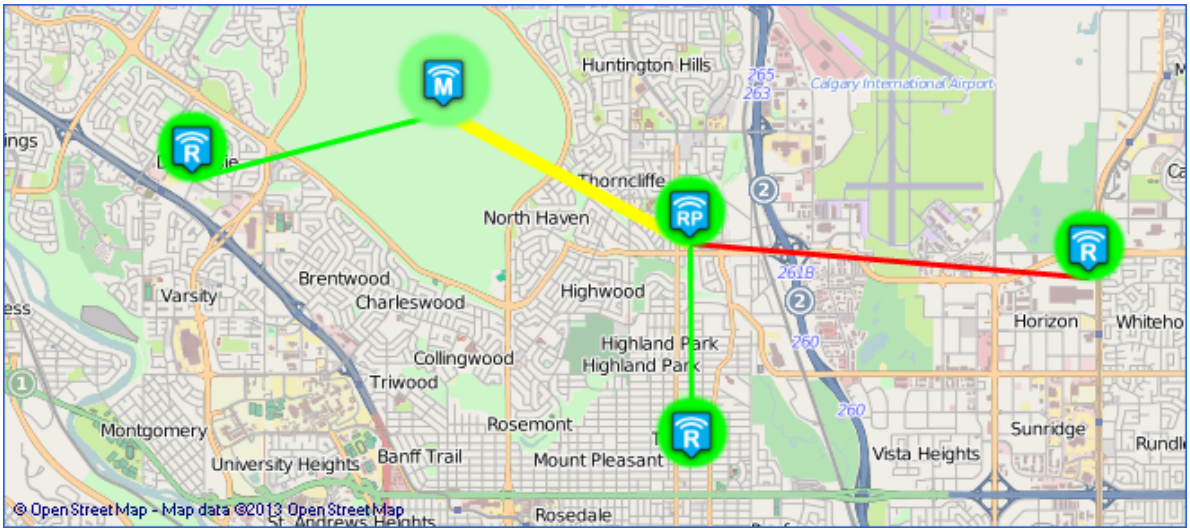
Map Display

The map display shows the actual road or satellite map. Icons are overlayed on the map to show the location and state of your radios:



Refer to the following topics for more information on the map display:

- Popup Help
- Panning and Zooming
- Selecting a Radio
- Map Context Menu
- Adding a Radio to the Map
- Moving a Radio on the Map

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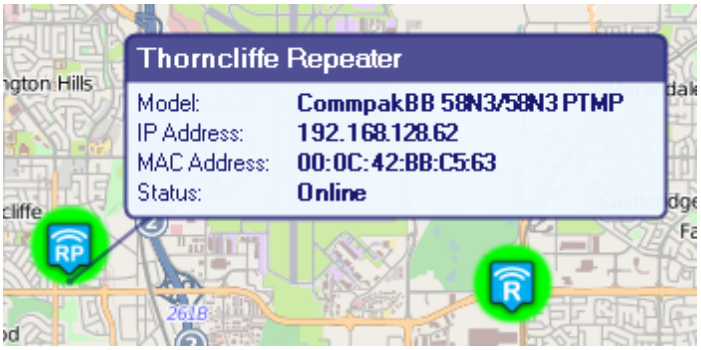
Map Popup Help

Placing your mouse pointer over a radio icon will display a popup-up help balloon that shows some important information about the radio.



Panning and Zooming

To pan the map (move it up, down, left or right), click and hold the left mouse button on the map. The mouse pointer will change to a directional cursor, as shown in the following example:

Move the mouse to pan the map in the desired direction. Release the mouse button when you are finished.

To zoom the map, click the left mouse pointer on the map, and then use the mouse wheel to zoom in or out.

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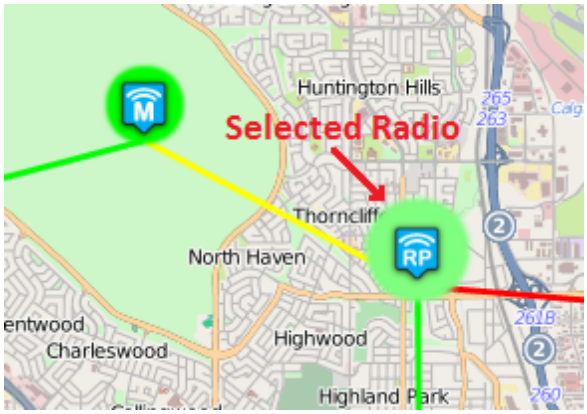
Selecting a Radio

Click the left mouse button on the radio icon to select the radio. A large circle (larger than the state indicator circle) is displayed behind the radio to highlight the fact that it has been selected. The color of the highlight circle matches the color of the radio state indicator displayed in the Radio List panel.



When you select a radio, the contents of the Radio List panel, Item Properties panel, Wireless Link Status panel and Network Traffic panel are automatically updated to reflect the newly selected radio.

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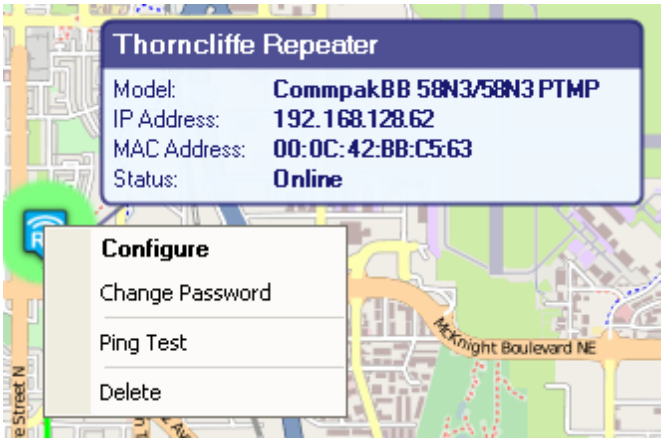
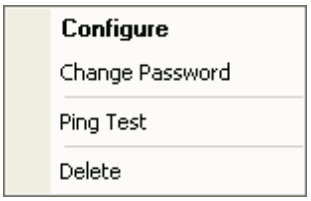
Map Context Menu

Click the right mouse button on the radio icon to display the map's context menu. This menu allows you to perform some common operations on the selected radio.



The context menu provides a convenient way to access functions that are already available in the main menu bar.

For more information on the individual context menu items, click the left mouse button on the menu text in the screenshot shown below:



Note that you can double-click the left mouse button on the radio icon to display the Radio Configuration form.

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Setting the Location of a Radio

To add radios to a ping test:

1. Select one or more radios, or one of more folders, in the Radio List panel. For information on selecting multiple radios or folders, refer to the Selecting Radios topic.
2. Select **Add to Ping Test** from the radio list context menu.
3. The Ping Test panel will be activated and shown if it was hidden.
4. The radios that were selected, or that are found in the folders that were selected, will be added to the *Ping Test* panel.
5. The ping test will automatically start if it is not already running.

Alternatively:

1. Make sure that the Ping Test panel is visible.
2. Select one or more radios, or one of more folders, in the Radio List panel. For information on selecting multiple radios or folders, refer to the Selecting Radios topic.
3. Click and hold the left mouse button on one of the items you selected.
4. Drag the items to the Ping Test panel.
5. Release the mouse button.
6. The radios that were selected, or that are found in the folders that were selected, will be added to the *Ping Test* panel.
7. The ping test will automatically start if it is not already running.

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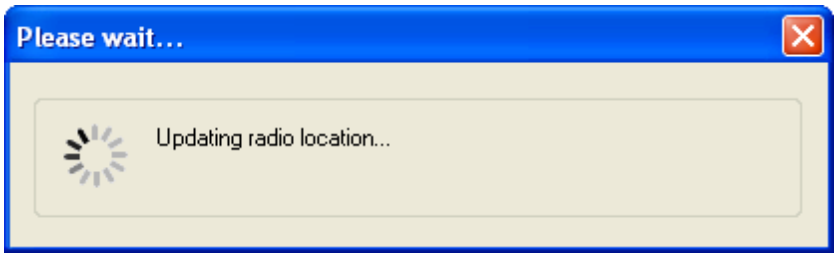
Moving a Radio on the Map

To move a radio to a new location on the map:

1. Press and hold down the **Shift** key.
2. Click and hold the left mouse button on the radio you want to move.
3. Drag the radio to its new location.
4. Release the mouse button.
5. Release the **Shift** key.
6. The new location will be saved to the radio.



NOTE Because the radio's location is stored in the radio's configuration settings, it must be on-line in order for its location to be set.

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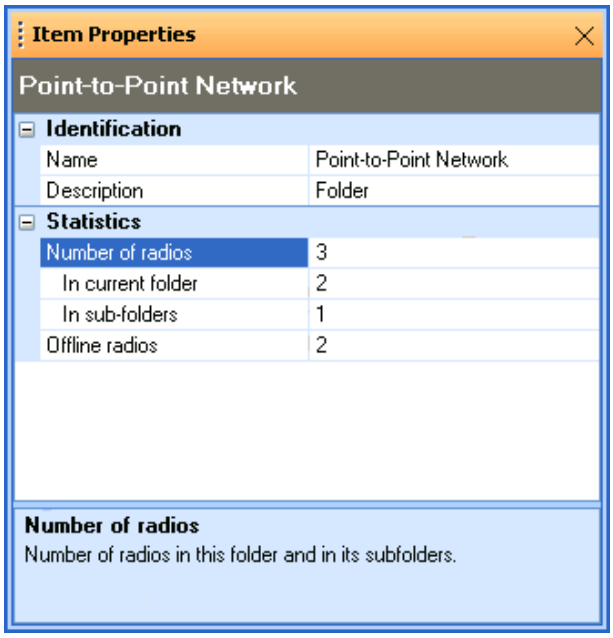
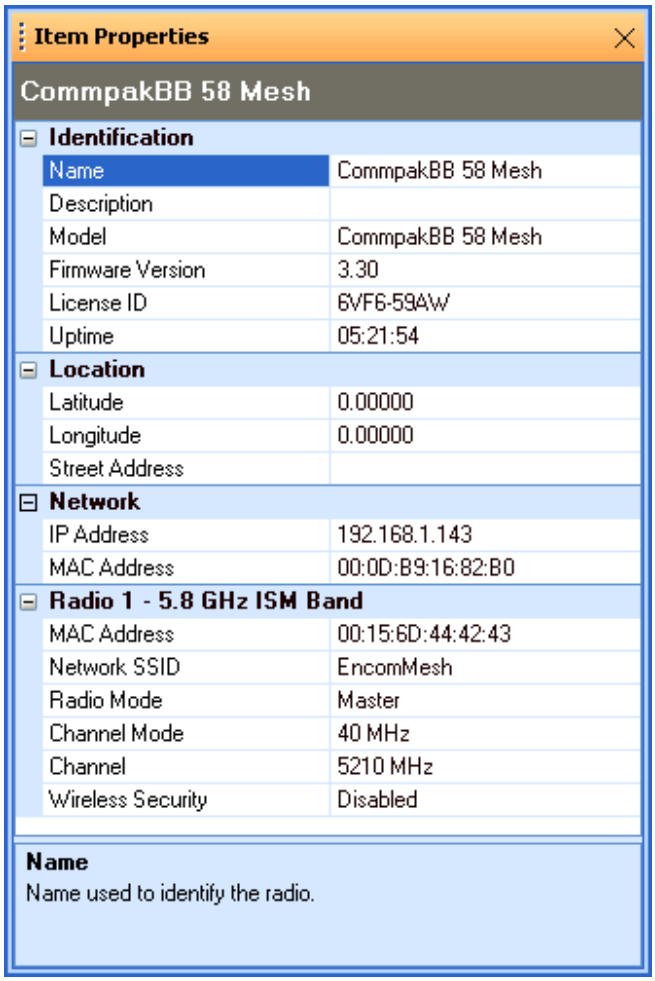
Item Properties Panel

The *Item Properties* panel displays a list of useful information associated with the selected folder or radio.



Folder Properties



Radio Properties

The panel is divided into two sections.

- The top section contains the list of properties and their current values.
- The bottom section contains a more detailed description of the currently selected property.

To select a property, simply click the left mouse button on the property name or value in the top section.

The example at the left shows the properties listed for a folder that is selected in the Radio List panel. The bottom section contains the description of the **Number of Radios** property that is selected in the top section.

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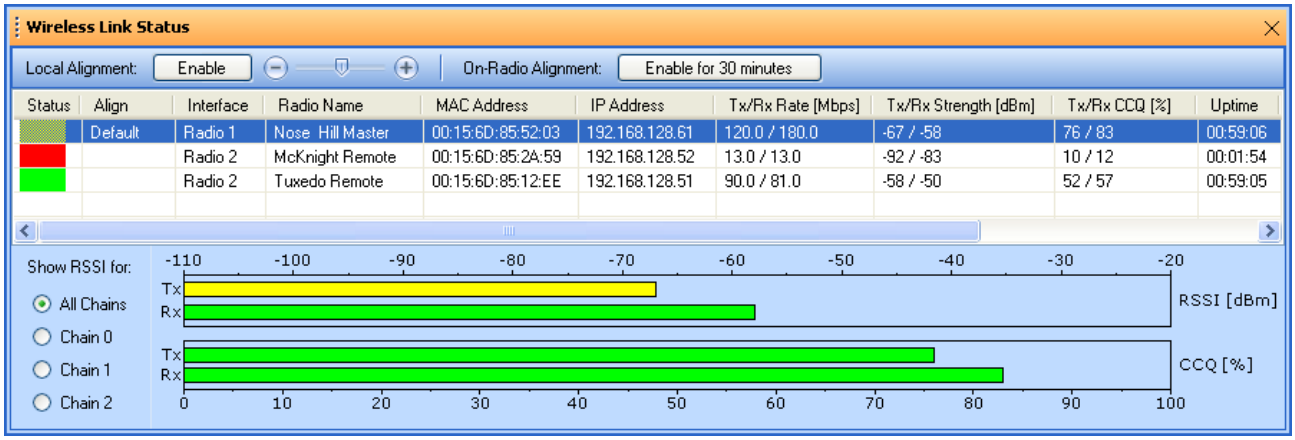
Wireless Link Status Panel

The *Wireless Link Status* panel displays the state of the wireless connections between the currently selected radio and the other radio or radios that are connected to it.

The information displayed in the *Wireless Link Status* panel is especially helpful when aligning the radio antennas (see the Deploying the Radios section for more information an aligning antennas).



The wireless link status panel contains the following user interface elements:

- Wireless Link Status Toolbar
- Wireless Link Status Table
- Wireless Link Status Bars

Refer to the following topics for more information regarding the features of the Wireless Link Status panel:

- Wireless Link RSSI Colors
- Wireless Link CCQ Colors
- Sorting the Wireless Link Status List
- Wireless Link Context Menu

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Wireless Link Status Toolbar

The Wireless Link Status toolbar allows you to control the local and remote (on-radio) antenna alignment functions.

The following table describes the options and controls found in the map toolbar:

Field Name	Description
Local Alignment Enable	The local antennal alignment button allows you to start and stop the local antenna alignment sound. To enable the local antenna alignment, click the **Enable** button (the button text will change to **Disable**). If a wireless link is present in the Wireless Link Status table, a sound will be played through the computer's speakers that reflects the transmitted signal strength of the selected wireless link. A higher pitch indicates a higher signal strength, and a lower pitch indicates a lower signal strength. To align the antenna of a radio: • Click the **Enable** button to start the antenna alignment process. • Select the radio (this is normally a radio that has a directional antenna). • Select the wireless link to monitor (if the radio has more than one active link). • Move the antenna to the left and right, as well as up and down, until the highest pitch sound is encountered. To stop the antenna alignment sound, click the **Disable** button.
Volume Control	The volume control allows you to increase or decrease the volume of the antenna alignment sound. With the volume control, you can: • Use the (-) button to decrease the volume. • Use the (+) button to increase the volume. • Use the slider to increase or decrease the volume.

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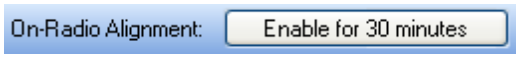
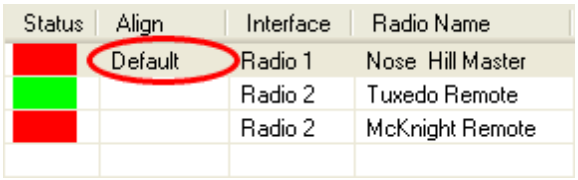
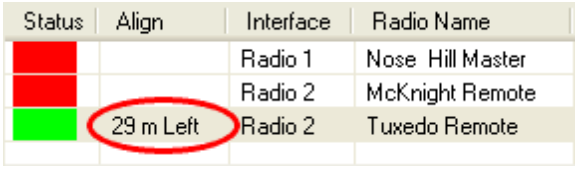
	The volume control only affects the antenna alignment sound. It will not affect other sounds that are being played through your computer's speaker.
On-Radio Alignment Enable	The on-radio antenna alignment button allows you to enable the on-radio antenna alignment tool.  The on-radio alignment tool is accessed through the radio's external audio jack. The audio jack is compatible with most stereo headphones or ear buds. A periodic beep indicates the transmitted signal strength of the radio's wireless links. A higher pitch indicates a higher signal strength, and a lower pitch indicates a lower signal strength. The on-radio antenna alignment tool is always active. By default, the alignment tool reflects the signal strength of the the first link on the first wireless interface (Radio 1), identified by the 'Default' indication in the Wireless Link Status table's **Align** column.  To instruct the alignment tool to monitor another link: • Select the link in the Wireless Link Status table. • Click the **Enable for 30 minutes** button. • The pitch of the beeps will now reflect the signal strength of the selected link. • The Wireless Link Status table's **Align** column will show a countdown timer on the link for which the alignment tool is active.  • When the countdown timer reaches 0, the on-radio alignment tool reverts to the 'Default' link.

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NOTE

The remote (on-radio) alignment function is only available on newer Encom radio models. If the selected radio does not support this functionality, STRATOS will not display the **On-Radio Alignment** option.

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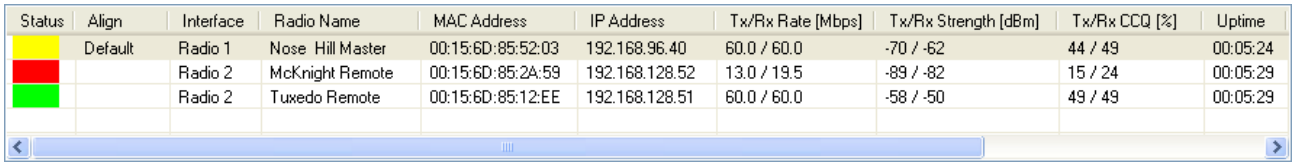
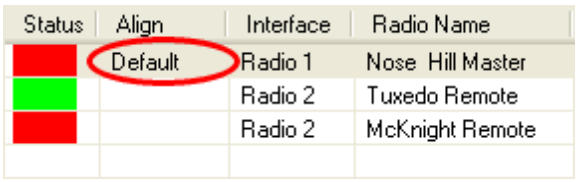
Wireless Link Status Table

The wireless link status table contains the list of currently active wireless connections.



Status	Align	Interface	Radio Name	MAC Address	IP Address	Tx/Rx Rate [Mbps]	Tx/Rx Strength [dBm]	Tx/Rx CCQ [%]	Uptime
	Default	Radio 1	Nose Hill Master	00:15:6D:85:52:03	192.168.96.40	60.0 / 60.0	-70 / -62	44 / 49	00:05:24
		Radio 2	McKnight Remote	00:15:6D:85:2A:59	192.168.128.52	13.0 / 19.5	-89 / -82	15 / 24	00:05:29
		Radio 2	Tuxedo Remote	00:15:6D:85:12:EE	192.168.128.51	60.0 / 60.0	-58 / -50	49 / 49	00:05:29

The following table describes the information that is displayed for each wireless connection:

Column	Description
Status	Displays the status of the wireless connection, based on the connection's current signal strength reading. The color of the status indicator matches the color displayed in the signal strength (RSSI) graph. The colors can be changed in the RSSI Threshold panel of the System Settings graph.
Align	Indicates the wireless link that the On-Radio Alignment tool is currently monitoring. Under normal circumstances, the first link on the first wireless interface (Radio 1) is automatically selected for monitoring. This link is identified by the 'Default' indication in the **Align** column.  If you send a command instructing the radio to monitor a specific link (using the **Enable for 30 minutes** button in the Wireless Link Status toolbar), the **Align** column will show a countdown timer on the link for which the alignment tool is active. Note that the **Align** column will be empty under the following conditions: • The On-Radio Alignment tool is in its default state, and there are no links active on the first wireless interface.

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<table>
<tr><td></td><td>The link selected for monitoring using the Enable for 30 minutes button is no longer active.
The radio does not support the On-Radio Alignment tool. In this case, the Enable for 30 minutes button is not available in the toolbar.</td></tr>
<tr><td>Interface</td><td>The wireless interface card on which the wireless connection is established.
The radio's first wireless card is displayed as Radio 1, the second card as Radio 2, and so on.</td></tr>
<tr><td>Radio Name</td><td>The name of the radio at the other end of the wireless connection. This is the name given to the radio when it was configured.</td></tr>
<tr><td>MAC Address</td><td>The MAC address of the radio at the other end of the wireless connection.
For broadband radios, a single MAC address is assigned to all of the wireless interface cards.
For mesh, point-to-point and point-to-multipoint radios, each wireless interface card has its own MAC address.</td></tr>
<tr><td>IP Address</td><td>The IP address of the radio at the other end of the wireless connection.
Each radio is assigned a single IP address, regardless of the number of wireless interface cards it has.</td></tr>
<tr><td>Tx/Rx Rate (Mbps)</td><td>The raw transmit and receive data rates of the wireless connection.
The data rates can be shown in a number of different formats, as described in the following table:
<table>
<tr><th>Format</th><th>Description</th></tr>
<tr><td>48</td><td>The raw throughput, in megabits per second.</td></tr>
<tr><td>54*2</td><td>This is displayed for 40 MHz channels. It indicates a raw throughput of 108 (54 * 2) megabits per second.</td></tr>
<tr><td>54/2</td><td>This is displayed for 10 MHz channels. It indicates a raw throughput of 27 (54 / 2) megabits per second.</td></tr>
<tr><td>48/4</td><td>This is displayed for 5 MHz channels. It indicates a raw throughput of 12 (48 / 4) megabits per second.</td></tr>
</table></td></tr>
</table>

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<table>
<tr><td></td><td>
<table>
<tr><td>11-SP</td><td>The 'SP' indicates that the link is operating in Short Preamble mode. This is a special low-overhead mode for 802.11b connections.
The '11' indicates a raw throughput of 11 megabits per second.</td></tr>
<tr><td>104.0-HT</td><td>The 'HT' indicates that the radio is operating in High Throughput (Wireless-N) mode.
The '104.0' indicates a raw throughput of 104 megabits per second.</td></tr>
</table>
</td></tr>
<tr><td>Tx/Rx Strength (dBm)</td><td>The current transmit and receive signal strength of the wireless connection. Refer to the Wireless Link RSSI Colors topic for information on the colors used in the signal strength graph.</td></tr>
<tr><td>Tx/Rx CCQ (%)</td><td>The current transmit and receive connection quality. Refer to the Wireless Link CCQ Colors topic for information on the colors used in the connection quality graph.</td></tr>
<tr><td>Uptime</td><td>The amount of time that the wireless connection has been active. This value is reset to 00:00:00 if the connection is dropped for any reason.</td></tr>
<tr><td>Chain 0 [dBm]</td><td>The current transmit and receive signal strength for the 1st antenna of a Wireless-N radio card.
If the radio card associated with the connection is not a Wireless-N card, the 1st antenna chain is not enabled, or the 1st antenna chain is not present, "--/--" is displayed.</td></tr>
<tr><td>Chain 1 [dBm]</td><td>The current transmit and receive signal strength for the 2nd antenna of a Wireless-N radio card.
If the radio card associated with the connection is not a Wireless-N card, the 2nd antenna chain is not enabled, or the 2nd antenna chain is not present, "--/--" is displayed.</td></tr>
<tr><td>Chain 2 [dBm]</td><td>The current transmit and receive signal strength for the 3rd antenna of a Wireless-N radio card.
If the radio card associated with the connection is not a Wireless-N card, the 3rd antenna chain is not enabled, or the 3rd antenna chain is not present, "--/--" is displayed.</td></tr>
<tr><td>Distance</td><td>The length of the wireless link, shown in miles and kilometers.
The distance is based on the location of the radios on the map. If the</td></tr>
</table>

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	radios are not correctly placed on the map, this value will not be correct. If either of the radios at each end of the link is not located on the map, <Unknown> is displayed.

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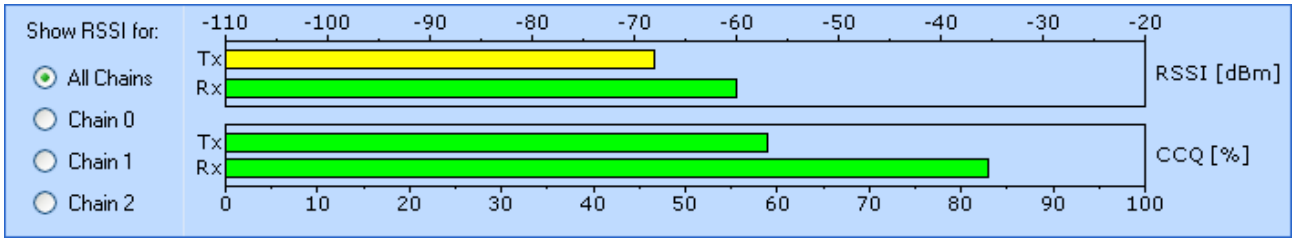
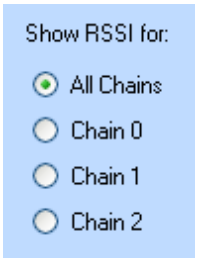
Wireless Link Status Bars

The bottom section of the Wireless Link Status panel contains a set of bar graphs that display the signal strength (RSSI) and client connection quality (CCQ) of the wireless link that is selected in Wireless Link Status table.



For connections that are associated with a Wireless-N radio card, a small panel is displayed at the left of the bar graphs. The panel allows you to select a specific antenna chain whose signal strength will be displayed in the RSSI chart. This feature can help you align the antennas associated with the Wireless-N connections.



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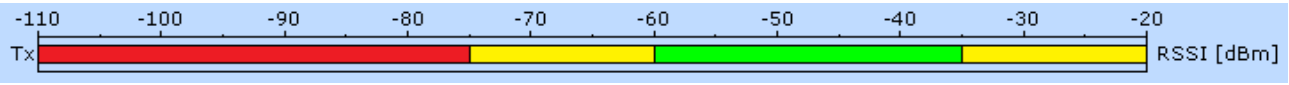
Wireless Link RSSI Colors

The color of the signal strength (RSSI) bars in the Wireless Link Status panel indicates the relative strength of the signal. By default, the following colors are used:

Color	Description
	The signal strength is much too low. The connection will probably not be stable, and will have low throughput.
	The signal strength too low. The connection will be marginal, and may not have good throughput.
	The signal strength is within the optimal range. The wireless connection should be stable, and will have good throughput.
	The signal strength is too high. The connection will be marginal, and may not have good throughput.

For Wireless-N radio cards, the following levels are used by default:



Color	Signal Strength
	-75 dBm or lower
	-75 dBm to -60 dBm
	-60 dBm to -35 dBm
	above -35 dBm

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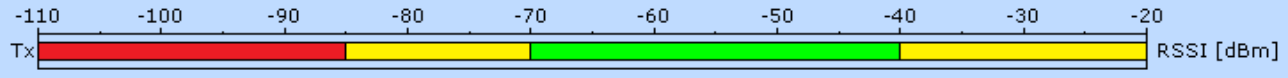
For other radio cards, the following levels are used by default:



Color	Signal Strength
	-85 dBm or lower
	-85 dBm to -70 dBm
	-70 dBm to -40 dBm
	above -40 dBm

You can change the default colors and thresholds in the RSSI Threshold panel in the System Settings form.

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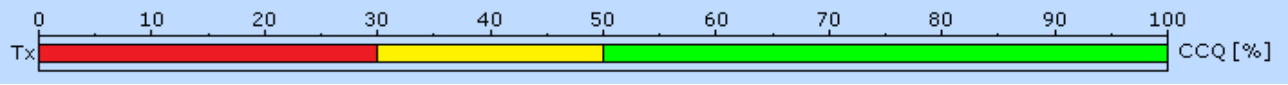
Wireless Link CCQ Colors

The color of the client connection quality (CCQ) bars in the Wireless Link Status panel indicate the relative quality of the signal. By default, The following colors are used:

Color	Description
	The signal quality is bad. The connection will probably not be stable, and will have low throughput.
	The signal quality is not very good. The connection will be marginal, and may not have good throughput.
	The signal quality is good. The wireless connection should be stable, and will have good throughput.

The following levels are used in the CCQ graph by default:



Color	Signal Strength
	30% or lower
	30% to 50%
	above 50%

You can change the default colors and thresholds in the CCQ Threshold panel in the System Settings form.

NOTE A low CCQ reading usually indicates that something is interfering with the signal. This could be physical problem (such as terrain, buildings or trees that are in the signal path), or a congestion problem (other radios operating on the same frequency and in close proximity to the ENCOM radio).

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Sorting the Wireless Link Status List

You can sort the wireless link status list by clicking the left mouse button on one of the following table headers:

- Interface
- Radio Name
- MAC Address
- IP Address

When you click on one of these headers, an arrow is displayed that indicates the direction of the sort.

Status	Align	Interface	Radio Name	MAC Address	IP Address
		Radio 2	McKnight Remote	00:15:6D:85:2A:59	192.168.128.52
	Default	Radio 1	Nose Hill Master	00:15:6D:85:52:03	192.168.128.61
		Radio 2	Tuxedo Remote	00:15:6D:85:12:EE	192.168.128.51

Click once to sort in ascending order, and click again to sort in descending order.

Wireless Link Context Menu

To display the *Wireless Link Status Test* context menu, click the right mouse button on a link in the Wireless Link Status Table. The following context menu is displayed:

The following table describes the commands available in the context menu.

Command	Description
Select Connected Radio	Selects the radio associated with the link. The STRATOS user interface will be updated to reflect the newly selected radio. You can also select the radio associated with the link by double-clicking the left mouse button on the link.

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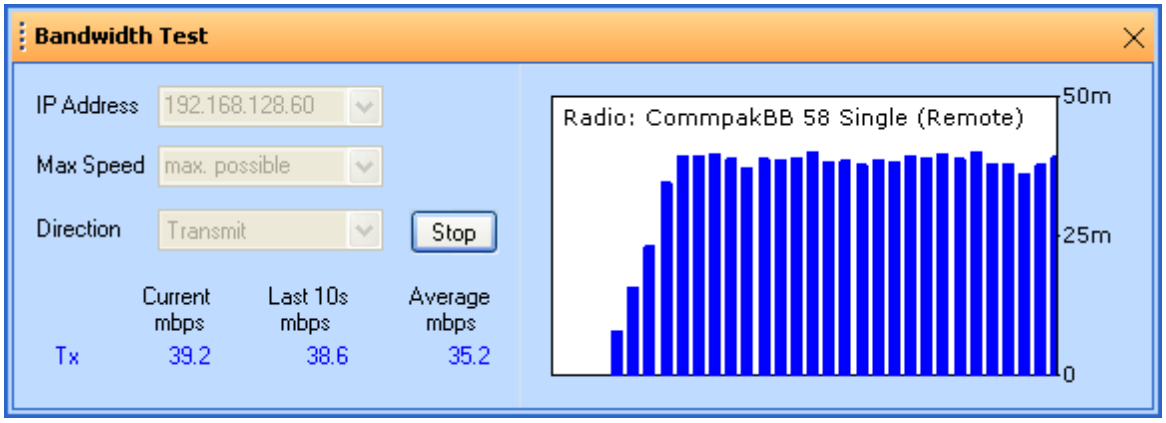
Bandwith Test Panel

The *Bandwidth Test* panel is used to determine the throughput of the wireless connections between the currently selected radio and the other radio or radios that are connected to it.



To check the throughput of a wireless connection:

1. Make sure that the *Bandwidth Test* panel is visible. If it is not currently visible:
   - In the main menu, navigate to the **View -> Panels** item, and verify that the **Bandwidth Test** option is checked.
   - If the *Bandwidth Test* panel is hidden behind another panel, click on the *Bandwidth Test* tab to bring it to the front of the other panels:

2. In the Radio List, select the radio that is closest to the computer running the ENCOM STRATOS application. This is either the radio that is connected to your network via its Ethernet port, or the radio that is the least number of wireless connections (hops) from your computer.

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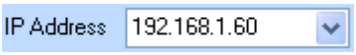
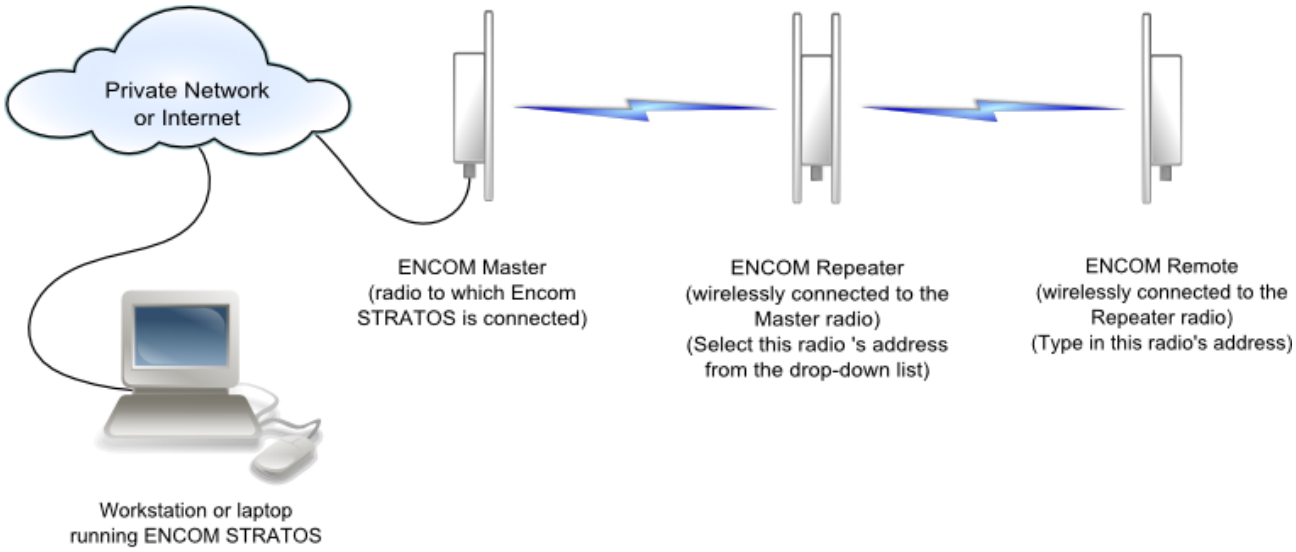
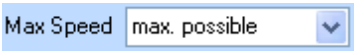
3. Specify the IP address of the remote radio in the **IP Address** list.



The drop-down list allows you to select the IP address of a remote radio that is wirelessly connected to your radio. If you want to test against a radio that is not directly connected to your radio (e.g. if your radio is wirelessly connected to a repeater, but you want to test against the remote radio to which the repeater is connected), manually type in the IP address of the remote radio. Please refer to the following diagram for more info.



4. Specify the rate at which you want to perform the test from the **Max Speed** list.



By default, this is set to the **max possible** value in order to help you determine the maximum throughput available on the wireless link. You can choose a different value from the drop-down list, or type in a value if you want to specify a rate that is not in the list. When entering a custom rate, use the 'k' and 'm' suffixes to specify kilobit and megabit rates, as shown in the following examples:

Value entered	Rate used for test
500000	500 kilobits per second
6000000	6 megabits per second
1200k	1.2 megabits per second
3m	3 megabits per second

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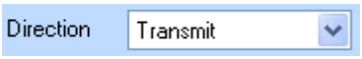
5. Select the direction in which the bandwidth test is to be performed from the **Direction** list.

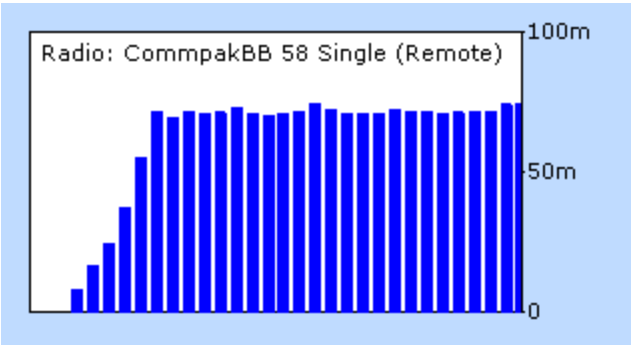


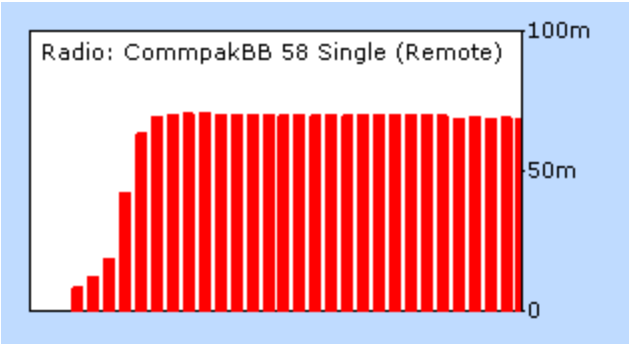
   To get a true understanding about the capacity of a link, you should run two bandwidth tests: one in the **Transmit** direction, and one in the **Receive** direction.

   When performing a combined Receive/Transmit test at the **max possible** speed, it is common for the link to polarize so most of the traffic is in one direction. This behavior will give you an incorrect impression of the link's quality.

6. Click the **Start** button to start the test. The button text will automatically change to 'Stop'.

7. The graph at the right in the *Bandwidth Test* panel will show the short term trending of the throughput. The following screen shots show typical results for the transmit and receive tests.





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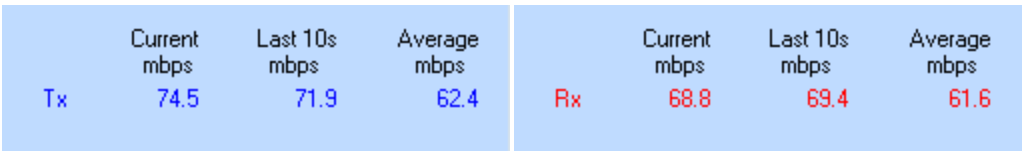
8. The values displayed at the left of the *Bandwidth Test* panel show the current and averaged bandwidth throughput. The following screen shots show typical results for the transmit and receive tests.



9. Press the **Stop** button to stop the test. The button text will automatically change to 'Start'.

NOTE Do not be too concerned with fluctuations that appear on the graph; the average numbers listed to the left of the graph are more important. Adding the average numbers gives you the link's effective throughput.

NOTE The available bandwidth depends on the channel mode you selected when configuring the radio. A smaller channel mode allows for greater link distances at the cost of lower bandwidth. A larger channel mode allows for shorter link distances but at greater bandwidth.

NOTE The available bandwidth can be affected by the signal strength, since a low signal strength can translate into low link rates.

NOTE If you have configured a maximum link rate (in the Basic Settings tab of the radio configuration form) with a low value, you will limit your available bandwidth.

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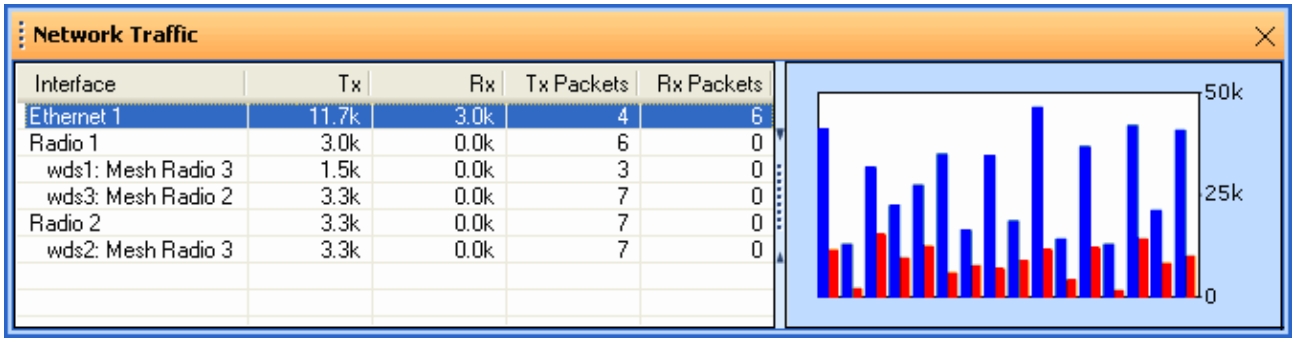
Network Traffic Panel

The *Network Traffic* panel displays the amount of traffic between the currently selected radio and the other radio or radios that are connected to it.



The table at the left shows all interfaces available on the radio. This includes the ethernet interfaces as well as the wireless interfaces.

For master and mesh radios, the traffic on each card is broken down to the individual wireless links that are formed between the wireless cards and the remote radios. In the example above, the **Radio 1** interface has two wireless connections associated with it: **wds1** and **wds3**. The wireless card's overall data rates consist of the sum of the data rates for all of the wireless links associated with the card.

The radio's first wireless card is displayed as **Radio 1**, the second card as **Radio 2**, and so on.

The graph at the right shows the short term trending of the traffic for the item that is selected in the table. Click the left mouse button on an item in the table to select it.

The following table describes the information that is displayed for each connection.

Column	Description
Interface	The interface being monitored.
Tx	The number of bytes transmitted on the interface.
Rx	The number of bytes received on the interface.
Tx Packets	The number of packets transmitted on the interface.
Rx Packets	The number of packets received on the interface.

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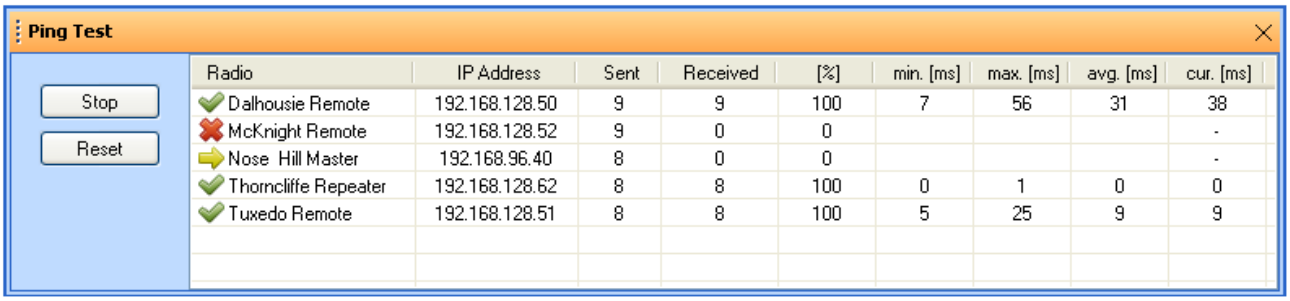
Ping Test Panel

The *Ping Test* panel displays the results of an on-going ping test.



A ping test consists of periodically sending ICMP message (pings) to a group of radios and recording the latency of the responses. The latency is the interval between the time at which the ICMP message is sent and the time at which the response is received.

To stop the ping test, click on the **Stop** button. The button text will automatically change to 'Start'.

To start the ping test, click on the **Start** button. The button text will automatically change to 'Stop'.

The **Reset** button allows you to restart the test while it is running. All of the statistics shown in the list are automatically reset to 0.

The following table describes the information that is displayed for each radio participating in the ping test.

Column	Description
Radio	The name assigned to the radio. The icon at the left of the radio name indicates the state of the test for the radio. One of the following icons is displayed: **Icon** / **State** No ICMP packets have been sent to the radio yet. An ICMP packet has been sent to the radio, but the response had not been received yet. STRATOS will wait a maximum of 2 seconds for a response before proceeding to the next radio. The radio responded in a timely fashion to the last ICMP packet sent to it. The radio did not respond to the last ICMP packet sent to it.
IP Address	The IP address of the radio.

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Column	Description
Sent	The number of ICMP packets sent to the radio.
Received	The number of replies received from the radio.
(%)	The percentage of replies received from the radio. 100% means that a reply was received for each ICMP packet sent to the radio.
min (ms)	The minimum latency encountered during the test.
max (ms)	The maximum latency encountered during the test.
avg (ms)	The average latency encountered during the test.
cur (ms)	The latency encountered during the last round of ICMP packets sent to the radio.

Refer to the following topics for more information regarding the features of the *Ping Test* panel:

- Carrying Out a Ping Test
- Sorting the Ping Test List
- Ping Test Context Menu

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Carrying Out a Ping Test

To carry out a ping test:

1. Select one or more radios, or one of more folders, in the Radio List panel. For information on selecting multiple radios or folders, refer to the Selecting Radios topic.
2. Select **Add to Ping Test** from the **Radio** menu.
3. The Ping Test panel will be activated and shown if it was hidden.
4. The radios that were selected, or that are found in the folders that were selected, will be added to the *Ping Test* panel.
5. The ping test will automatically start if it is not already running.

Alternatively:

1. Make sure that the Ping Test panel is visible.
2. Select one or more radios, or one of more folders, in the Radio List panel. For information on selecting multiple radios or folders, refer to the Selecting Radios topic.
3. Click and hold the left mouse button on one of the items you selected.
4. Drag the items to the Ping Test panel.
5. Release the mouse button.
6. The radios that were selected, or that are found in the folders that were selected, will be added to the *Ping Test* panel.
7. The ping test will automatically start if it is not already running.

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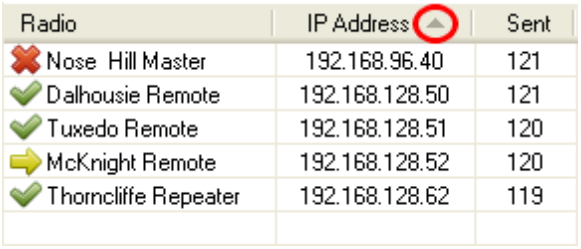
Sorting the Ping Test List

You can sort the ping test list by clicking the left mouse button on any of the table headers.

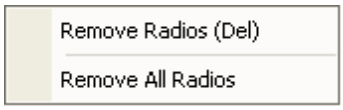
When you click on one of the headers, an arrow is displayed that indicates the direction of the sort.



Click once to sort in ascending order, and click again to sort in descending order.

Ping Test Context Menu

To display the *Ping Test* context menu, click the right mouse button anywhere on the ping test list. The following context menu is displayed:



The following table describes the commands available in the context menu.

Command	Description
Remove Radios (Del)	Removes the selected radios from the list. If no more radios are left, the ping test is automatically stopped.
Remove All Radios	Removes all radios from the list, and stops the ping test if it is currently running.

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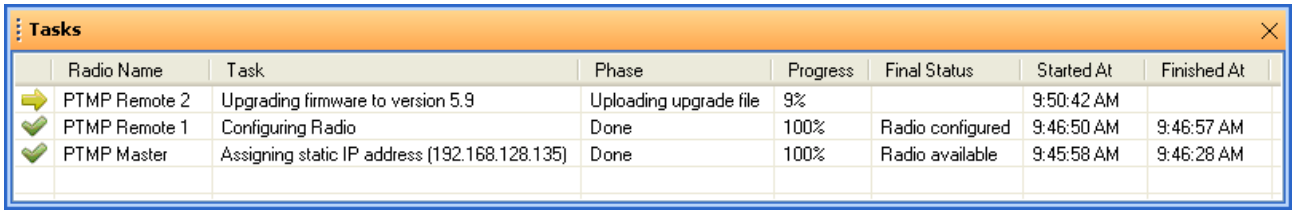
Tasks Panel

The *Tasks* panel displays the current state of long-running tasks.



Tasks that are displayed in the *Tasks* panel include:

- Configure Radio
- Find Radio
- Assign Static IP Address
- Restore to Factory Defaults
- Upgrade Firmware

The following table describes the information that is displayed for each task shown in the list.

Column	Description
Status	The icon at the left of the task name indicates the state of the task. One of the following icons is displayed: Icon / State The task is currently in progress. The task completed successfully. The task did not complete successfully.
Radio Name	The name of the radio on which the task is being performed. If the task is not associated with a particular radio, "<Not Applicable>" is displayed.
Task	Short description of the task being performed.
Phase	The current phase of the task being performed. Most long running tasks consist of two phases: • The operation requested (e.g. upgrading the firmware) • Waiting for the radio to restart
Progress	The progress of the current phase. Since most tasks take an

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Column	Description
	indeterminate amount of time to complete, this is a rough estimate.
Final Status	Indicates the state of the task when it has finished. If the task was not successful, the error that caused the task to fail is displayed.
Started At	The time at which the task was started.
Finished At	The time at which the task completed.

Refer to the following topics for more information regarding the features of the *Ping Test* panel:

- Task List Context Menu

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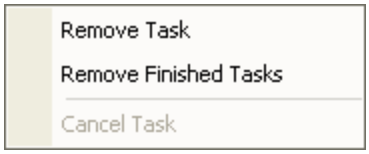
Task List Context Menu

To display the *Task List* context menu, click the right mouse button anywhere on the *Task List* panel. The following context menu is displayed:



The following table describes the commands available in the context menu.

Command	Description
Remove Task	Removes the currently selected and finished task from the list. This option is grayed out if a finished task is not currently selected.
Remove Finished Tasks	Removes all finished tasks from the list.
Cancel Task	Allows you to cancel the task that is currently selected. This option is grayed out if a task is not currently selected, or if the selected task is already finished. **Note:** Canceling a task during the *Restart Radio* phase will not have any effect on the outcome of the task, since the actual operation has already been carried out. (STRATOS is simply waiting for the radio to come back on-line after being restarted.)

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Spectrum Scan Panel

The *Spectrum Scan* panel allows you to visualize the external wireless traffic that exists in a radio's frequency band. You can use this information to decide the best frequency to assign to the radio. In most situations, you want to use a frequency that has the least amount of traffic, as interference from external sources will adversely affect a wireless connection's effective bandwidth.

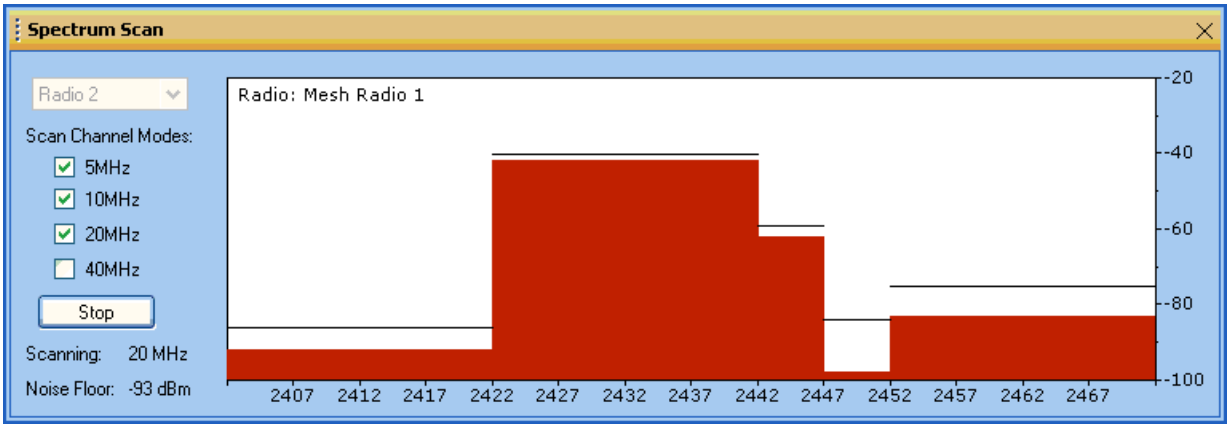
The spectrum scan function uses one of the radio's wireless interface cards to scan for external wireless traffic. When the spectrum scan function is started, any wireless connections associated with that wireless interface are dropped.

If you are not directly connected to the radio using an Ethernet cable, and the wireless interface you selected for the scan is the only connection between the radio and your network, you will either:

- Temporarily lose connection to the radio when you start the scan.
- Permanently lose connection to the radio when it switches to a channel mode that is different from channel mode of the repeater or master radio with which it communicates.

Because of these scenarios, ENCOM recommends that this function only be used when STRATOS is directly connected to the radio with an Ethernet cable.

A typical *Spectrum Scan* panel is shown below:



To view the wireless traffic in the vicinity of a radio:

1. Make sure that the *Spectrum Scan* panel is visible. If it is not currently visible:
   - In the main menu, navigate to the **View -> Panels** item, and verify that the **Spectrum Scan** option is checked.

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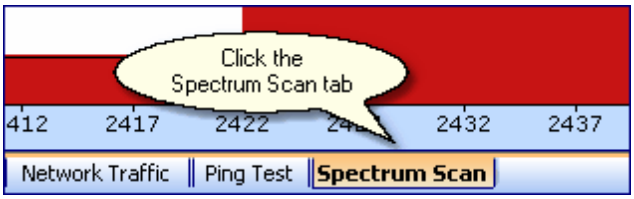
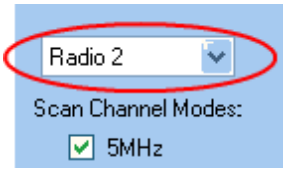
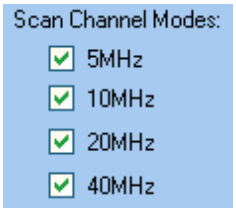
- If the *Spectrum Scan* panel is hidden behind another panel, click on the *Spectrum Scan* tab to bring it to the front of the other panels:



2. In the Radio List, select the radio you want to use for the spectrum scan.
3. Select the wireless interface to use from the drop-down list box in the upper left-hand corner of the *Spectrum Scan* panel.



4. When you select a wireless interface, all of the channel modes supported by the wireless interface card are automatically checked:



   If you do not want STRATOS to scan all channel modes, simply uncheck the channel modes you do not wish to scan.

5. Press the **Start** button to start the scan. The button text will automatically change to 'Start'. STRATOS will cycle through each of the selected channel modes at 10 second intervals. The wireless interface card will be configured to use the appropriate channel mode for each scan. If you lose connection to the radio due to a channel mode change, it may no longer be possible to communicate with it. If this occurs, you will need to recover the radio using one of the following techniques:

   - Connect an Ethernet cable to the radio, and use STRATOS to change its channel mode back to the original setting.

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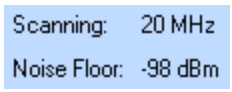
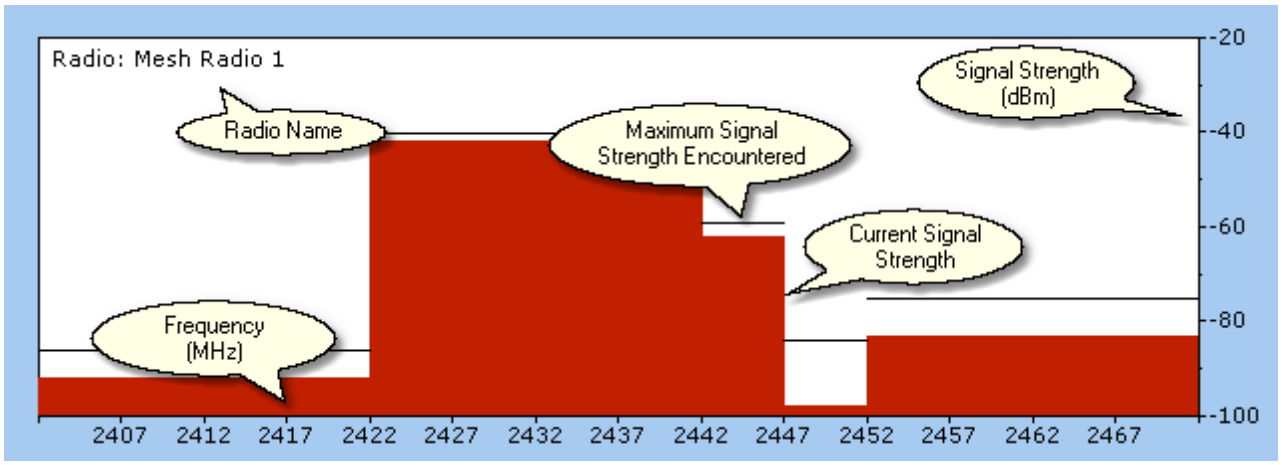
- Modify the configuration of the radios between STRATOS and the lost radio so that it is possible to communicate with the lost radio. In this case, you may have to change the channel mode of all the intermediate radios, starting with the radio closest to the lost radio, to the channel mode of the lost radio. Since you may not know the channel mode currently assigned to the lost radio, you may need to try different channel modes until you find the right one. Once you are able to communicate with the lost radio, restore the channel modes of all radios, starting with the lost radio and ending with the radio closest to the computer on which STRATOS is running.

6. While the spectrum scan is active, the **Scanning** and **Noise Floor** fields (below the Start/Stop button) will show the active channel mode and the approximate noise floor:



The noise floor shows the minimum signal strength required for the radio to discriminate between a valid signal and background noise. In practice, the signal strength of a wireless connection should be at least 20 dB above the signal floor in order for the connection to be stable.

7. While the spectrum scan is active, the strength of the wireless traffic for each frequency channel is displayed in the graph. The red bars show the current strength of the wireless traffic, and horizontal black lines shows the maximum signal strength encountered (in dBm), as shown in the following screen shot:



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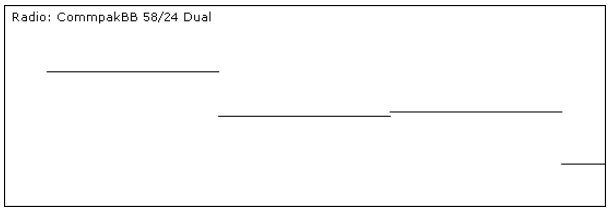
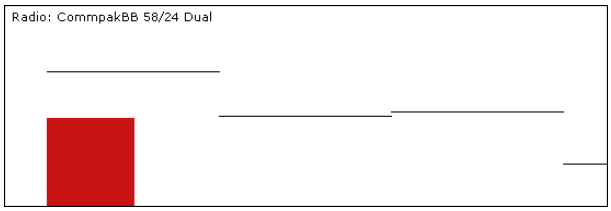
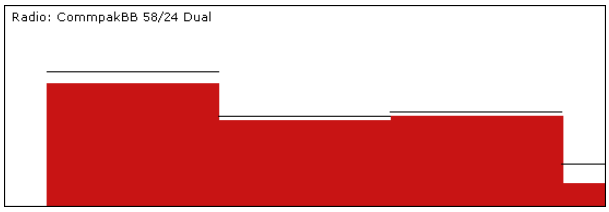
If you have selected more than one channel mode, STRATOS will cycle through each of the selected channel modes at 10 second intervals. The graph will display the traffic encountered in the currently active channel mode. If there is no traffic in the active channel mode, the graph is left blank. The following graphs show a typical spectrum scan session where all of the channel modes are being scanned:



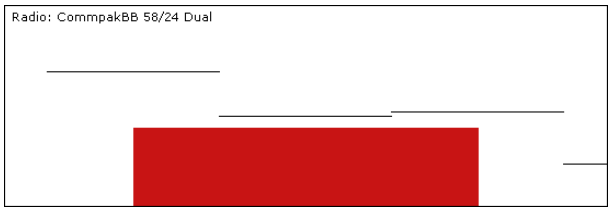
5 MHz Channel Mode



10 MHz Channel Mode



20 MHz Channel Mode



40 MHz Channel Mode

8. In order to get a good idea of the maximum wireless traffic in your area, you should let the spectrum scan run for a reasonable period of time (at least a couple of minutes).
9. Press the **Stop** button to stop the scan. The button text will automatically change to 'Start'.

NOTE	Due to the way in which Wireless-N technology is implemented, the 20-MHz and 40-MHz channel modes will display the same information when the spectrum scan is being performed with a Wireless-N radio card.

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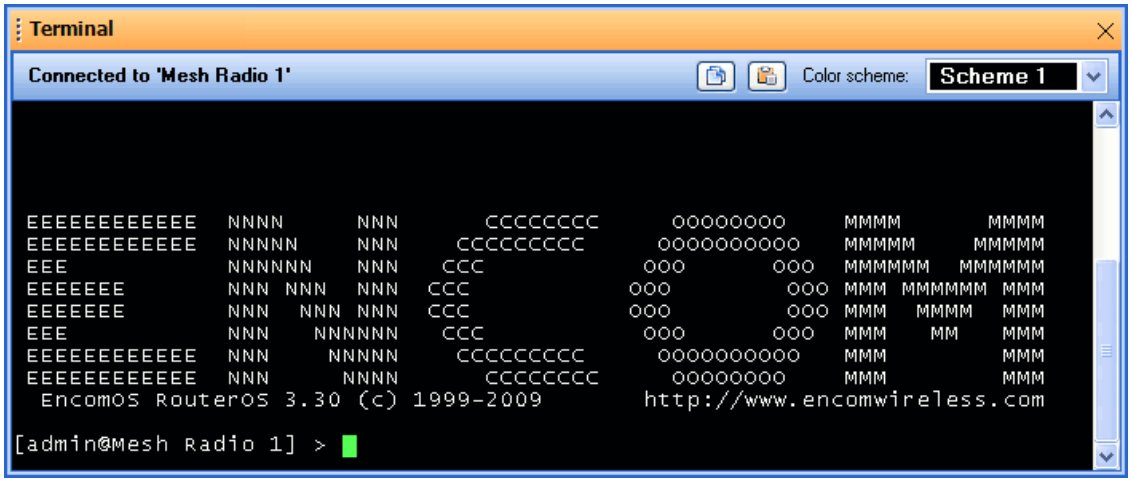
Terminal Panel

The *Terminal* panel allows you to interact with the currently selected radio using an SSH based terminal session. The panel is only visible when the terminal session is active.


Terminal
Connected to 'Mesh Radio 1'
Color scheme:
Scheme 1
EEEEEEEEEEEE NNNN NNN CCCCCCCCC OOOOOOOOO MMMM MMMM
EEEEEEEEEEEE NNNNN NNN CCCCCCCCCC OOOOOOOOOO MMMMM MMMMM
EEE NNNNNN NNN CCC OOO OOO MMMMMM MMMMMM
EEEEEEE NNN NNN NNN CCC OOO OOO MMM MMMMMM MMM
EEEEEEE NNN NNN NNN CCC OOO OOO MMM MMMM MMM
EEE NNN NNNNNN CCC OOO OOO MMM MM MMM
EEEEEEEEEEEE NNN NNNNN CCCCCCCCC OOOOOOOOO MMM MMM
EEEEEEEEEEEE NNN NNNN CCCCCCCC OOOOOOOO MMM MMM
EncomOS RouterOS 3.30 (c) 1999-2009 http://www.encomwireless.com
[admin@Mesh Radio 1] >

The terminal panel is meant to be used for troubleshooting issues with the help of ENCOM technical support personnel. A description of the terminal commands available to the radio is beyond the scope of this document.

To connect to a radio using the terminal panel:

1. Select the radio you want to connect to from the Radio List.
2. Select **Radio -> Terminal Connect** from the STRATOS menu.
3. When connected, enter the appropriate commands using the keyboard. Press the 'Enter' key to execute the commands.

To disconnect from the radio, perform one of the following:

- Click on the ✕ at the right of the panel's title bar.
- Select **Radio -> Terminal Disconnect** from the STRATOS menu.
- Enter the 'quit' command in the terminal window.

Refer to the following topics for more information regarding the features of the *Ping Test* panel:

- Terminal Toolbar

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Terminal Toolbar

The terminal toolbar allows you to change the look of the terminal window, and to interact with the Windows clipboard.

The following table describes the options and controls found in the map toolbar:

Field Name	Description
Connected to...	The left-hand label displays the name of the radio to which the terminal is connected.
Copy to Clipboard button	Click on the **Copy to Clipboard** button to copy the selected text from the terminal display to the Windows clipboard. To select text in the terminal display: 1. Press and hold down the left mouse button at the start of the block of text you want to copy. 2. Drag the mouse to the end of the block of text you want to copy. 3. Release the left mouse button. 4. Click the **Copy to Clipboard** button to copy the highlighted text.
Paste from Clipboard button	Click the **Paste from Clipboard** button to paste text from the Windows clipboard to the terminal.
Color Scheme	The right-hand drop down list box allows you to choose the color style for the terminal window text.

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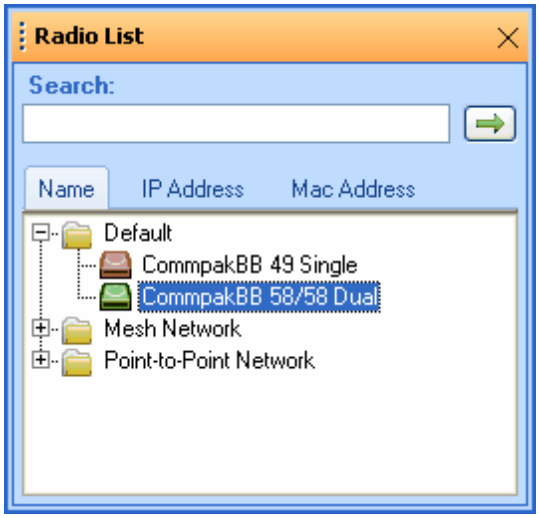
Configuring Broadband Radios

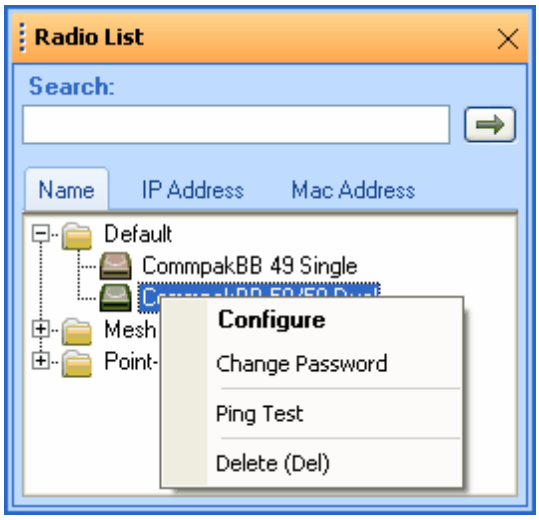
To configure a broadband radio:

1. Locate the radio you would like to configure in the Radio List. Ensure that it is currently on-line (a green icon is displayed at the left of an on-line radio):



2.

3. Click the right mouse button on the radio name, and select **Configure** from the pop-up menu that is displayed:



Alternatively, you can either double-click the left mouse button on the radio name, or click the left mouse button on the radio name, and select **Radio -> Configure** from the main menu.

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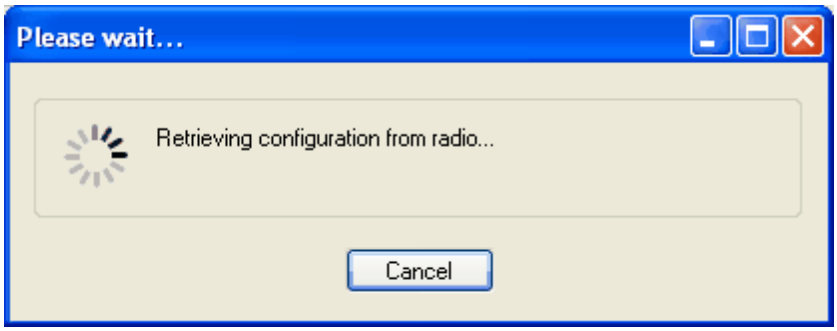
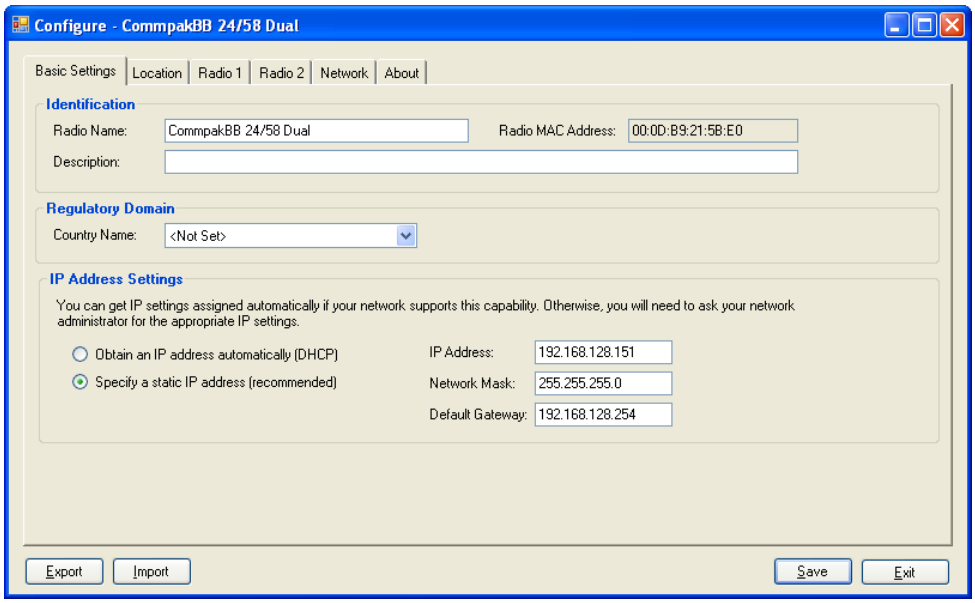
4. STRATOS will download the radio's current configuration. This process will normally take a few seconds to complete. During this time, a wait form is displayed:



5. When the radio's configuration has been obtained, the radio configuration form is displayed:



The configuration settings are logically grouped using a tabbed interface. The following topics describe the settings found in each tab:

- Basic Settings tab
- Location tab
- Radio tab
- Network tab
- About tab

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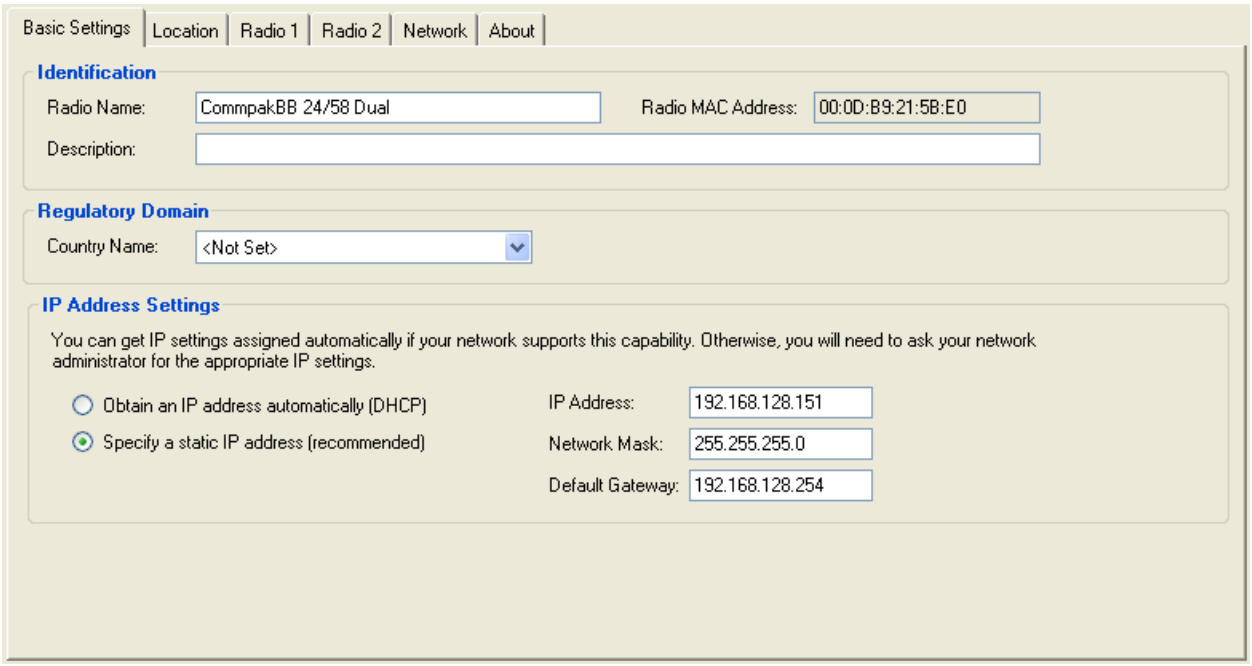
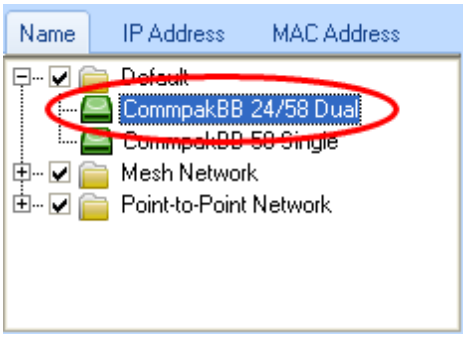
Basic Settings Tab

The following screen shot shows the basic configuration settings tab for a broadband radio:



The following tables describe the settings found in each group in the basic settings tab.

Identification	
Field Name	**Description**
Radio Name	Enter a name used to identify the radio (up to a maximum of 64 characters). The name you enter will be displayed in the radio list, and in all other places where a reference to the radio is made: 
Radio MAC Address	Displays the MAC address assigned to the radio. (This is essentially the MAC address of the radio's first Ethernet adapter.)

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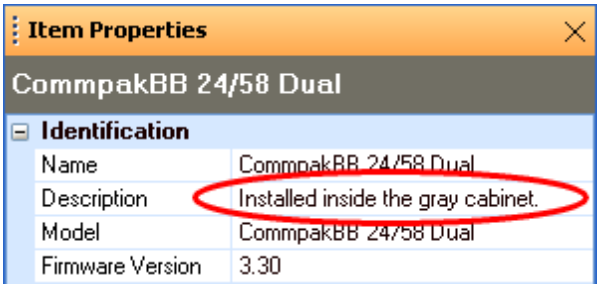
Identification	
Field Name	**Description**
Description	Enter an optional description for the radio. This field allows you to keep track of ad-hoc information associated with the radio, without adding clutter to the radio name. The radio description is displayed in the radio properties panel: 

Regulatory Domain	
Field Name	**Description**
Country Name	Select the country in which the radio is operating. Certain countries have limitations on the radio power output, allowed frequency ranges and frequency bands. Failure to select the appropriate country can result in a radio that is operating outside of the legally allowed ranges. If the radio is operating in the United States or Canada, you can leave this setting to **<Not Set>**.

IP Address Settings	
Field Name	**Description**
Obtain an IP address automatically	Select this option if a DHCP server is available on your radio network, and you want the DHCP server to assign an IP address to the radio.
Specify a static IP address	Select this option to manually assign the radio's IP address. ENCOM recommends this option because it provides for a more secure network (especially if you have not enabled wireless security). **Note:** It is important that each radio in the network is assigned a different IP address. Network performance can suffer greatly if two or more radios are assigned the same IP address.

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IP Address Settings	
Field Name	**Description**
IP Address	Enter the IP address of the radio. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:
Network Mask	Enter the network mask. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:
Default Gateway	Enter the IP address of the radio or router that allows the radio to connect with devices that are outside of their local LAN or VLAN. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: Note that the default gateway's IP address must be in the same subnet as the radio's IP address.

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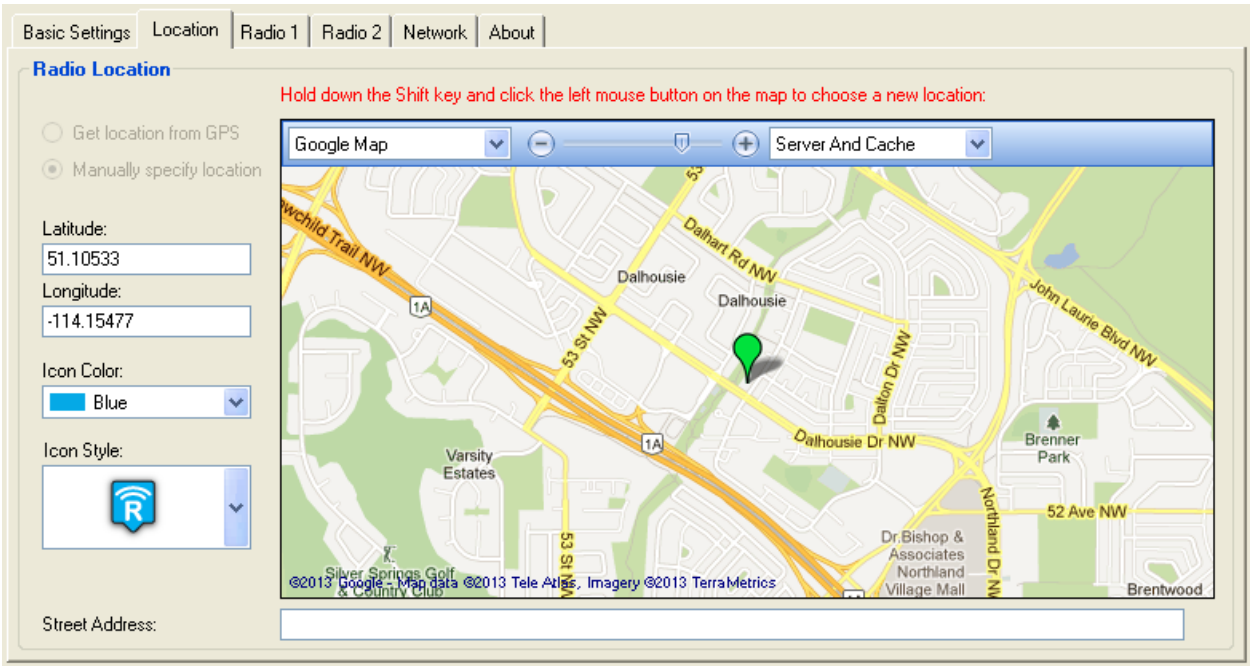
Location Tab

The following screen shot shows the location settings tab for a broadband radio:



The following table describes the settings found in the location tab.

Field Name	Description
Get location from GPS	Select this option if you want the radio to get its location from the built-in GPS receiver. This option is not available if the radio does not contain a GPS receiver.
Manually specify location	Select this option if you want to manually specify the location of the radio.
Latitude	Enter the latitude at which the radio is located, in decimal degrees. This value is positive in the northern hemisphere and negative in the southern hemisphere. Alternatively, hold down the Shift key and click the left mouse button on the map to set the radio's position. This process will automatically update the **Latitude** field.
Longitude	Enter the longitude at which the radio is located, in decimal degrees. This value is positive in the eastern hemisphere and negative in the western hemisphere. Alternatively, hold down the Shift key and click the left mouse button on the map to set the radio's position. This process will automatically update

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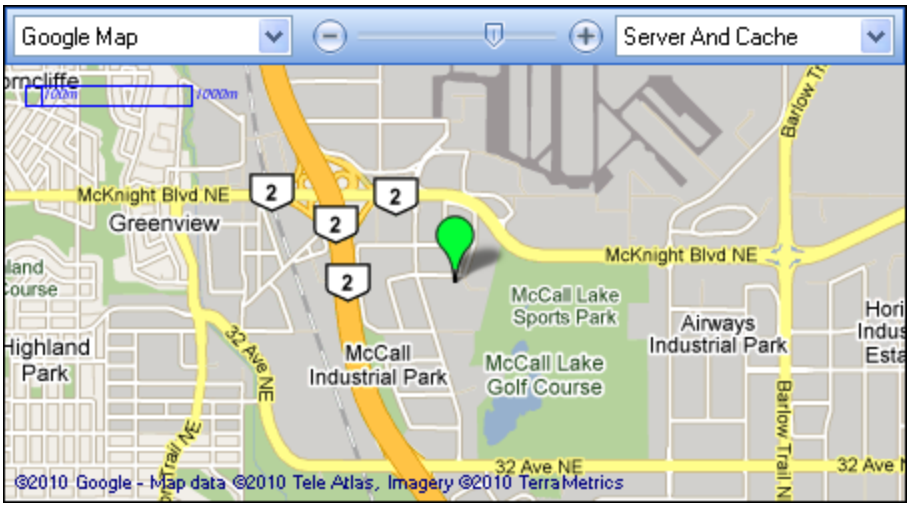
<table>
<tr><td></td><td>the Longitude field.</td></tr>
<tr><td>Icon Color</td><td>Select the color of the radio icon. You can use the icon color to visually group radios by radio type, geographical location, VLAN association, etc.</td></tr>
<tr><td>Icon Style</td><td>Select the style of the radio icon. Four icon styles are currently available:
<table>
<tr><th>Icon</th><th>Radio Type</th></tr>
<tr><td> </td><td>Generic radio</td></tr>
<tr><td> </td><td>Master radio</td></tr>
<tr><td> </td><td>Remote radio</td></tr>
<tr><td> </td><td>Repeater radio</td></tr>
<tr><td> </td><td>Dual radio</td></tr>
</table></td></tr>
<tr><td>Embedded map</td><td>The embedded map allows you to see the current location of the radio. A green marker shows the location assigned to the radio.


To set a new location:</td></tr>
</table>

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	• Press and hold down the Shift key on your computer's keyboard. • Click the left mouse button at the location you want to assign to the radio. • The green marker will move to the selected position. **Note:** Refer to the Map Panel topic for more information on the embedded map features.
Street Address	Enter the street address of the radio, if applicable. This information is optional.

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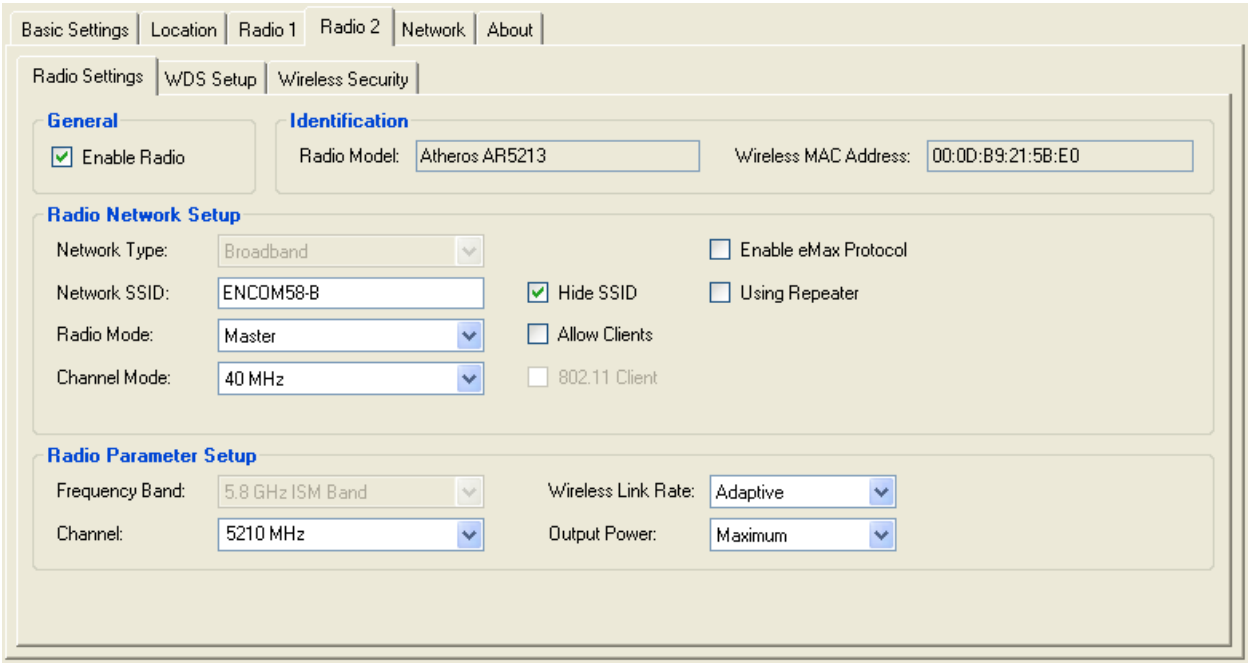
Radio Tab

ENCOM broadband radios contain at least one, and as many as four, wireless radio modules. Each wireless radio module is configured in its own tab. The first radio module is configured in the **Radio 1** tab, the second radio is configured in the **Radio 2** tab, and so on.

The following screen shot shows the radio settings tab for a broadband radio:



Because the wireless radio settings are somewhat involved, the radio configuration tab is split up into three sub-tabs. The following topics describe the settings found in each sub-tab:

- Radio Settings sub-tab
- WDS Setup sub-tab
- Wireless Security sub-tab

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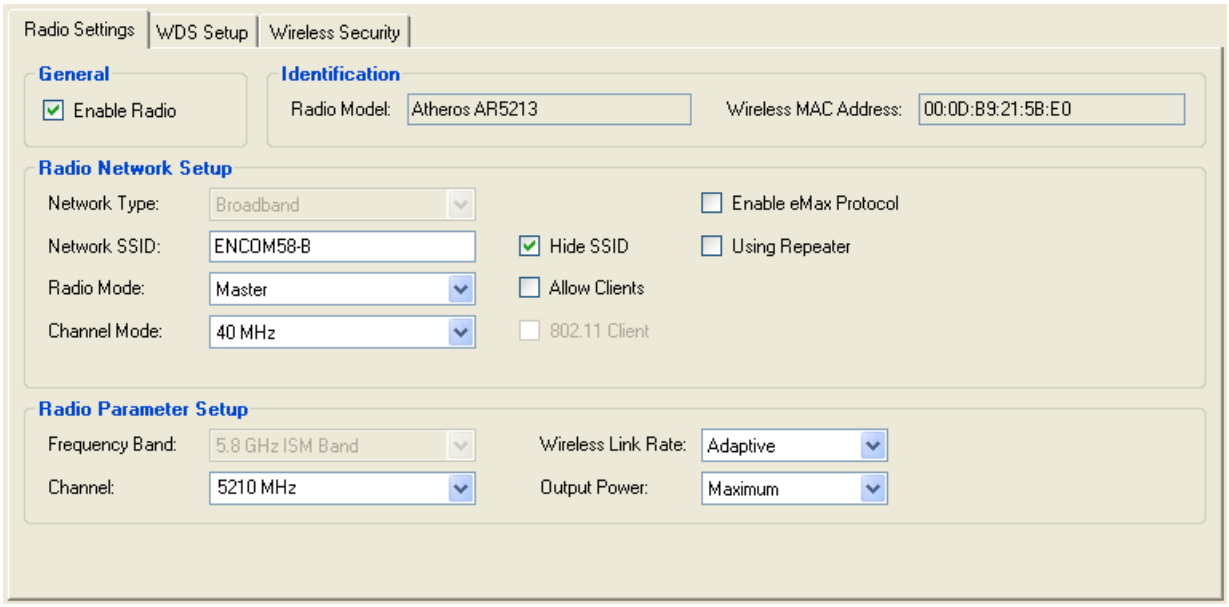
Radio Settings

The following screen shot shows the wireless radio settings tab for a broadband radio:



The following tables describe the settings found in each group in the wireless radio settings tab.

General	
Field Name	**Description**
Enable Radio	Uncheck this option to disable the wireless radio card. A disabled radio card will not be able to form wireless links with other radios. If you uncheck this option, all of the other options in the *Radio Settings* tab will be disabled.

Identification	
Field Name	**Description**
Radio Model	Displays the model number of the wireless radio card. This information is useful when troubleshooting issues with the radio.
Wireless MAC Address	Displays the MAC address assigned to the wireless radio card. For broadband radios, the MAC address of the wireless radio cards are identical to the MAC address of the radio's Ethernet interface.

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Radio Network Setup	
Field Name	**Description**
Network Type	Identifies the radio network type. This setting cannot be changed for broadband radios.
Network SSID	Enter a name used to identify the network in which the wireless radio will take part. The Network SSID is case sensitive, and may contain spaces. **Note:** You should change the default SSID assigned at the factory to a unique SSID for your network. You can minimize interference between adjacent networks by assigning a unique SSID for each network. **Important:** All radios that participate in the same network must be assigned the same Network SSID.
Hide SSID	Check this option to prevent the Network SSID from being broadcast by the wireless radio. This prevents external devices from being able to discover the network's SSID (and potentially connect to it).
Radio Mode	Select the radio mode based on the location of the radio with respect to the network operations center. Refer to the following topics for more information on radio mode options that are available: • Master Radio Setup • Repeater Radio Setup • Remote Radio Setup
Allow Clients	Check this option to allow external 802.11 compliant devices, such as laptops, WiFi cameras, etc. to connect to the radio. **Note:** This option is not compatible with the eMax protocol. If checked, the eMax protocol is automatically disabled. **Note:** Since most 802.11 compliant devices only support 20 MHz channels, you should set the **Channel Mode** option to 20 MHz when you select this option. **Note:** This option is only available for Master and Repeater radios. Remote radios do not support client devices.

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Radio Network Setup	
Field Name	**Description**
Channel Mode	This option allows you to set the width of the frequency channel you are using. Selecting a smaller frequency for the **Channel Mode** increases the distance over which you can establish a wireless link, at the cost of reduced bandwidth. For most applications, a 40 MHz channel mode is acceptable. **Note:** If you check the **Allow Clients** option to support 802.11 compliant devices, you should choose the 20 MHz channel mode.
802.11 Client	Check this option if the radio needs to connect to a non-Encom WiFi network.
Enable eMax Protocol	Check this option to enable the eMax protocol. The eMax protocol is a proprietary protocol that increases bandwidth and security on the wireless network. **Note:** Due to compatibility issues, the eMax protocol cannot be used if there is a repeater in the network, or if 802.11 clients need to be supported by the radio.
Using Repeater	Check this option if there is a repeater in the network.
Enable Roaming	Refer to the **Radio Mode** topics (see links above) for information on this option.
Parent Radio MAC Address	Refer to the **Radio Mode** topics (see links above) or information on this option.

Radio Parameter Setup	
Field Name	**Description**
Frequency Band	Displays the nominal frequency at which the radio operates. This option can be changed if the radio card supports more than one band.
Channel	Select the radio's operating frequency. In **Auto-Frequency** mode, a master radio automatically searches for the frequency that has the least activity. It then selects that frequency and uses it to communicate with the repeater or remote radios. For the most stable link, you should select a specific frequency from the list of available frequencies. (You can use the STRATOS Spectrum Scan

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Radio Parameter Setup	
Field Name	**Description**
	panel to determine the channel that has the least amount of activity in the vicinity of the radio.) If a repeater is present in the network, both the master and repeater radios must be set to the same specific frequency. Remote radios are always configured to run in **Auto-Frequency** mode. They will automatically adjust their operating frequencies to match the master's.
Wireless Link Rate	Select the rates at which the radio will communicate with the other radios in the network. The default setting for this option is **Adaptive**. The **Adaptive** link rate automatically adjusts the radio's data rate to account for the current network conditions. It typically provides the most reliable network performance. A fixed rate helps reduce data latency, and may be used if the performance of the link is more important than the reliability. If you select a fixed rate, a second drop-down list box is displayed, as shown in the following example: Select the minimum allowed bit rate from the left-hand list, and the maximum allowed rate from the right-hand list. Regardless of the range you specify, the 6 Mbps rate will always be included in the list of allowable rates. This allows the radio to fall back to the lowest bit rate if it is not able to maintain the higher bit rates.
Output Power	Select the wireless radio's output power. Unless constrained by the Regulatory Domain that the radio is operating in, you should use the *Maximum* power setting when the radio is deployed in the field. If the radio is being provisioned or tested in a bench environment, you should use the *Low* power setting.

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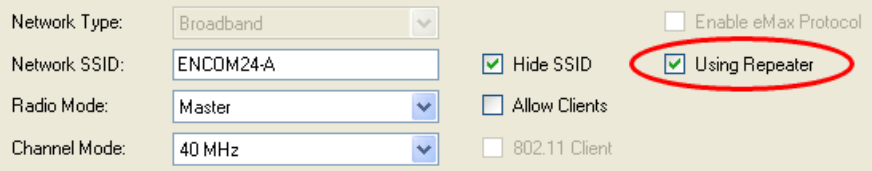
Master Radio Setup

Select the **Master** option for the radio that is located closest to the network operations center. This radio is usually connected to the network via the Ethernet port.

The master radio controls the flow of data in the network and serves as the network's synchronization source. Each broadband network has only one master radio. All the other radios must be configured as either remote or repeater radios.

If the network contains a repeater radio, check the **Using Repeater** option (note that this option is only available when the eMax Protocol is disabled).



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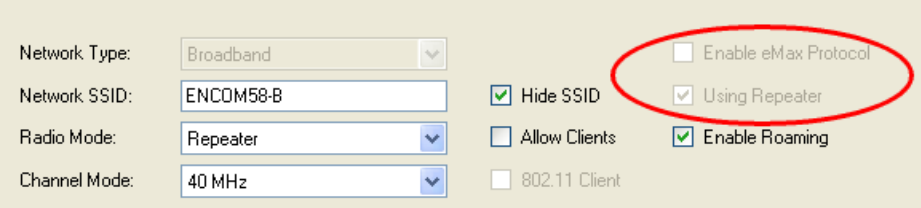
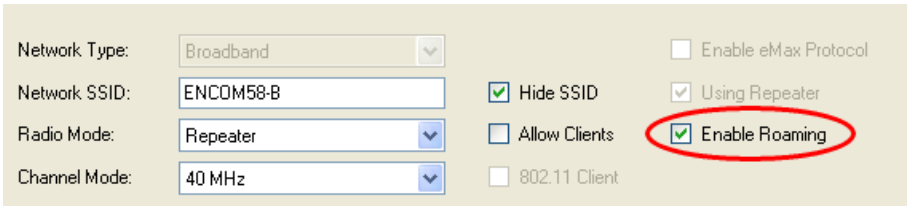
Repeater Radio Setup

Select the **Repeater** option for a radio that provides a link between the master and remote radios.

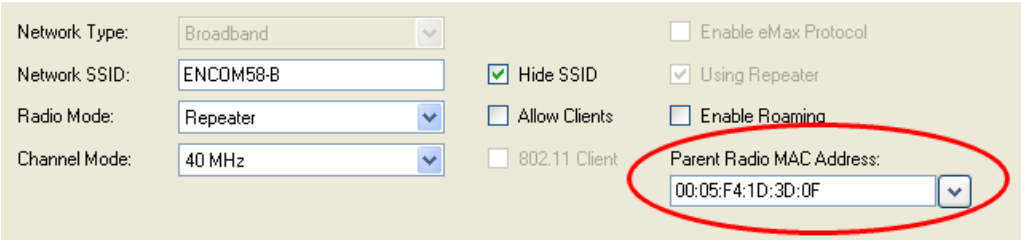
When this option is selected, the **Using Repeater** option is automatically checked, and the **Enable eMax Protocol** option is unchecked (the eMax protocol cannot be used when there is a repeater in the network).



By default, the **Enable Roaming** option is checked. This causes the repeater radio to automatically detect and communicate with the master radio.



If you encounter connectivity issues between the repeater and the master radio, you may want to manually select the master radio to which the remote will connect. To do this, uncheck the **Enable Roaming** option. The **Parent Radio MAC Address** option will be displayed.



Enter the MAC address of the master radio in the **Parent Radio MAC Address** option.

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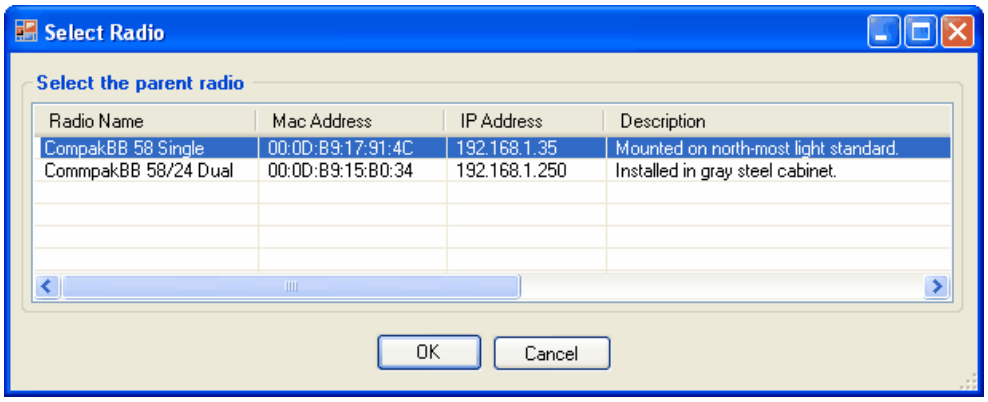
Alternatively, click on the button at the right of the MAC address field. The *Select Radio* form will be displayed. This form lets you choose the master from the list of radios that are currently connected to the repeater.



NOTE Note that installing a repeater will reduce the network throughput by half. It should only be used when there is no other option available, or if the reduction in performance is not important.

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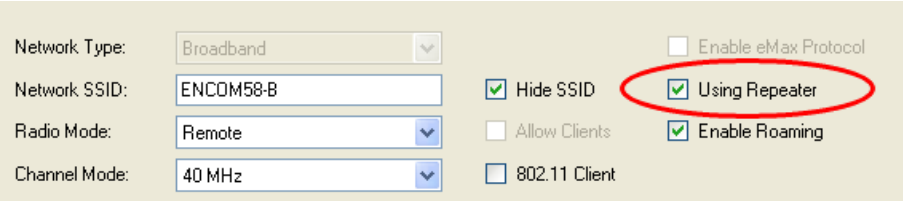
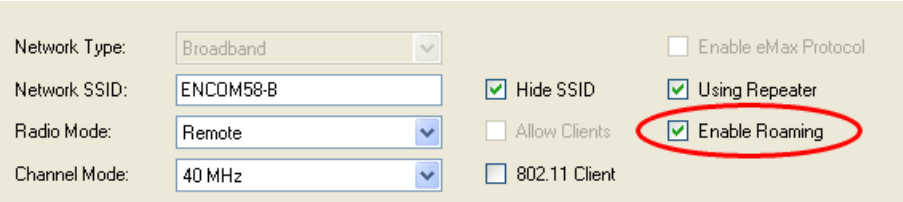
Remote Radio Setup

Select the **Remote** option for a radio that is as the end of the broadband network.

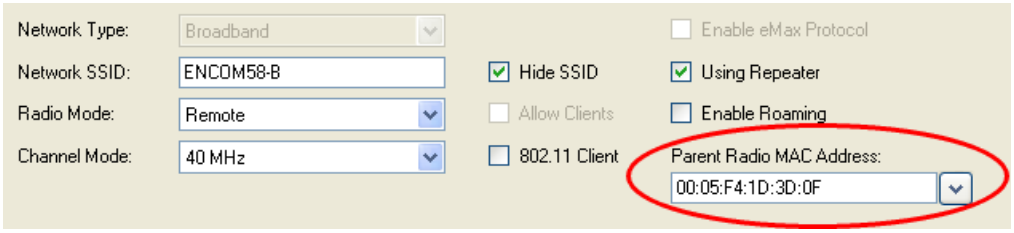
If the network contains a repeater, check the **Using Repeater** option (note that this option is only available when the eMax Protocol is disabled).



By default, the **Enable Roaming** option is checked. This causes the remote radio to automatically detect and communicate with the master or repeater.



If you encounter connectivity issues between the remote radio and the master or repeater, you may want to manually select the radio to which the remote will connect. To do this, uncheck the **Enable Roaming** option. The **Parent Radio MAC Address** option will be displayed.



Enter the MAC address of the master or repeater to which the remote will connect in the **Parent Radio MAC Address** option.

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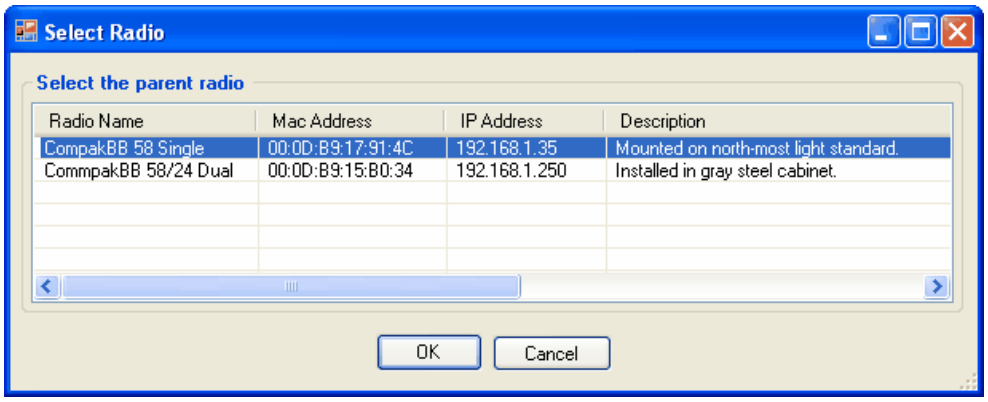
Alternatively, click on the button at the right of the MAC address field. The *Select Radio* form will be displayed. This form lets you choose the parent from the list of radios that are connected to the current radio.



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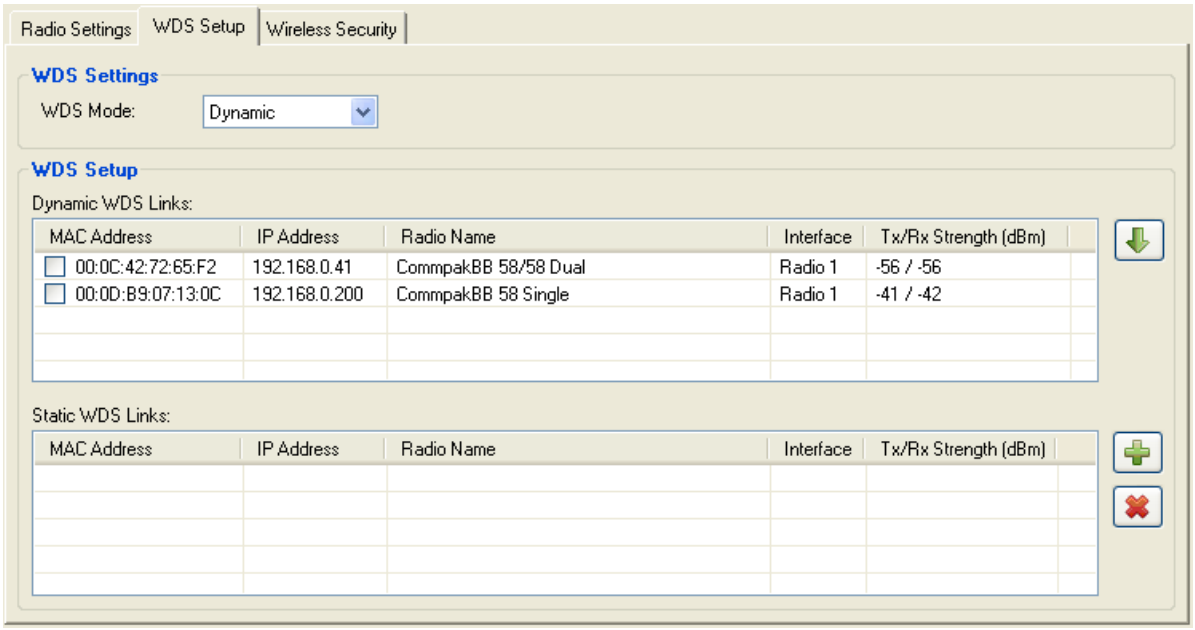
WDS Setup

The following screen shot shows the *WDS Setup* tab for a broadband radio:



The settings on this tab are used to specify the WDS (Wireless Distribution System) connections that are allowed to form with other radios in the network.

The following tables describe the settings found in each group in the *WDS Setup* tab.

<table>
<tr><th colspan="2">WDS Settings</th></tr>
<tr><th>Field Name</th><th>Description</th></tr>
<tr><td>WDS Mode</td><td>Select the method used to determine if an external radio is allowed to form a wireless connection with the radio being configured. One of the following options can be used:
<table>
<tr><th>WDS Mode</th><th>Description</th></tr>
<tr><td>Dynamic</td><td>All connections from other radios will be accepted. This is the default, and recommended, setting.</td></tr>
<tr><td>Static</td><td>Only those connections listed in the Static WDS Links table will be allowed to form.</td></tr>
<tr><td>Disabled</td><td>No connections from other radios will be accepted. This defeats the purpose of a wireless network, and is not recommended.</td></tr>
</table>
</td></tr>
</table>

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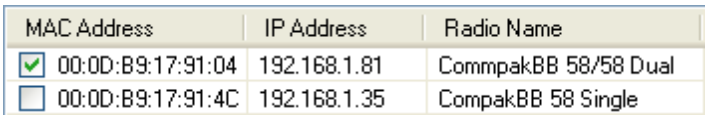
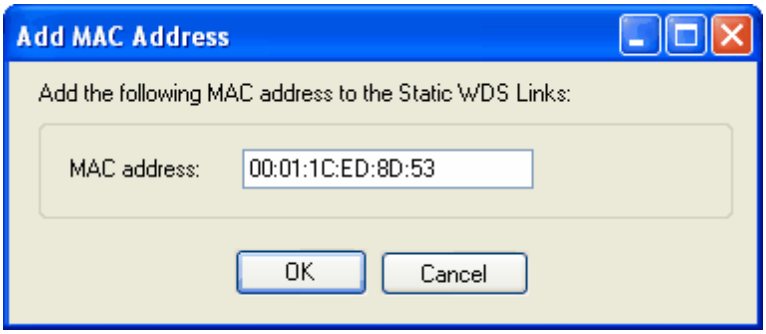
WDS Setup	
Field Name	**Description**
Dynamic WDS Links	This list contains the list of WDS links that are currently active.
 (Move button)	Click on the **Move** button to convert dynamic WDS links to static links. The links will be transferred from the **Dynamic WDS Links** list to the **Static WDS Links** list. To convert dynamic WDS links to static WDS links: 1. Select one or more links in the **Dynamic WDS Links** table. To select a link, check the associated check box. In the following example, the first WDS link is selected.  2. Click on the **Move** button to convert the selected dynamic links to static links.
Static WDS Links	This list contains the list of WDS links that are allowed to form.
 (Add button)	Click on the **Add** button to manually add the MAC address of a remote radio to the static WDS list. When selected, the following form is displayed:  Specify the MAC address of the radio you want to allow, and press the **OK** button. The new MAC address will be added to the **Static WDS Links** list. **Note:** If you add the MAC address of a radio that is not known to ENCOM STRATOS, only the MAC address will be displayed in the disallowed list. If the radio is known to STRATOS, the associated IP Address and radio name will be included. Both scenarios are shown in the following example:

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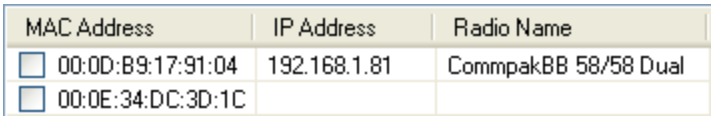
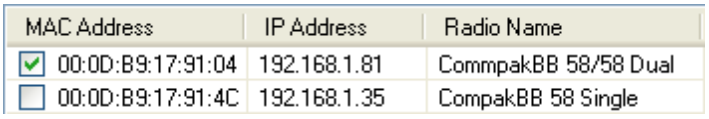
WDS Setup	
Field Name	**Description**
	
 (Remove button)	Click on the **Remove** button to remove links from the static WDS list. To remove static WDS links: 1. Select one or more links in the **Static WDS Links** table. To select a link, check the associated check box. In the following example, the first WDS link is selected.  2. Click on the **Remove** button to remove the selected static links.

The following table describes the information that is displayed in the Dynamic and Static WDS Link tables:

Column	Description
MAC Address	The MAC address of the remote radio.
IP Address	The IP address of the remote radio.
Radio Name	The name assigned to the remote radio.
Interface	Identifies the wireless radio module on the remote radio. The first radio module is **Radio 1**, the second radio module is **Radio 2**, etc.
Tx/Rx Strength	The transmit and receive signal strengths, in dBm, of the wireless connection between this radio and the remote radio.

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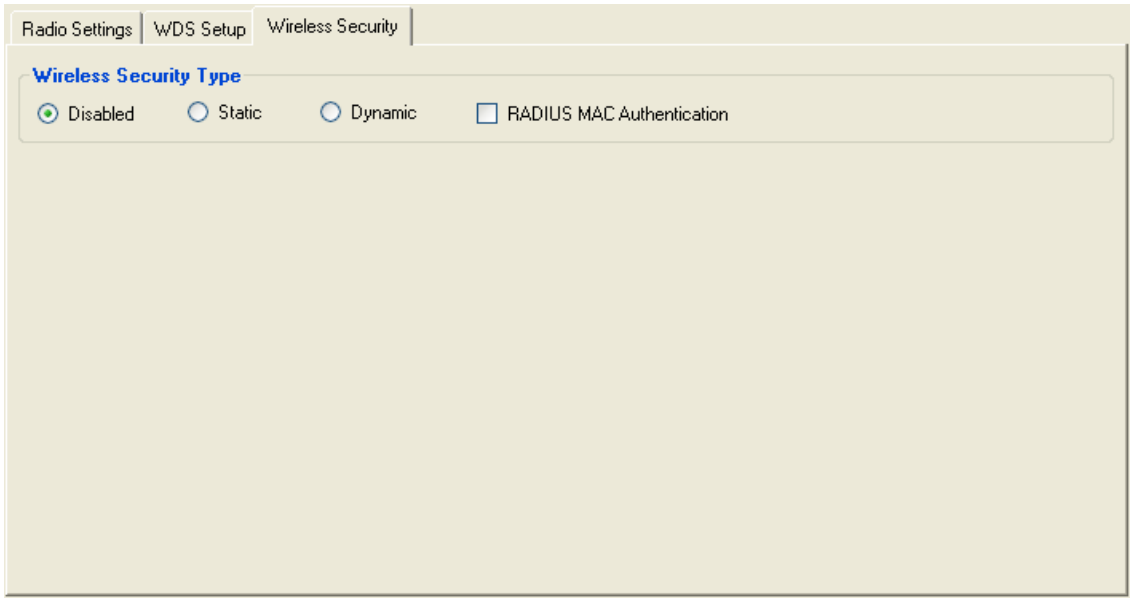
Wireless Security Settings

The following screen shot shows the wireless security settings tab for a broadband radio:



The Wireless Security Type group allows you to specify the security protocols used to protect the wireless communication links. You can choose from the following options:

Wireless Security Types	
Option	**Description**
Disabled	Select this option if you do not want to enable security. This option is not recommended since it allows anyone that has knowledge of the Network's SSID to connect to the network.
Static	This option enables wireless encryption that uses static keys. This is an older technology that is not as secure as the Dynamic option. It can, however, provide for a more stable network.
Dynamic	This option enables wireless encryption that uses dynamically allocated keys. This option provides the most secure communication link.
RADIUS MAC Authentication	Check this option if you use a RADIUS server for authentication. A Remote Authentication Dial in User Service (RADIUS) server acts as a centralized access and authorization point for network service. The authentication service is then handled by the RADIUS server instead of the ENCOM radios.

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Important: The security settings must be the identical for all radios on the network. Radios that have different security settings will not be able to communicate with each other.

Note: Encom Wireless Data Solutions highly recommends that you confer with your I.T. department to determine the appropriate level of security for your network.

The Static and Dynamic security options contain additional settings that need to be configured. The following topics describe these in more detail:

- Static Security Options
- Dynamic Security Options

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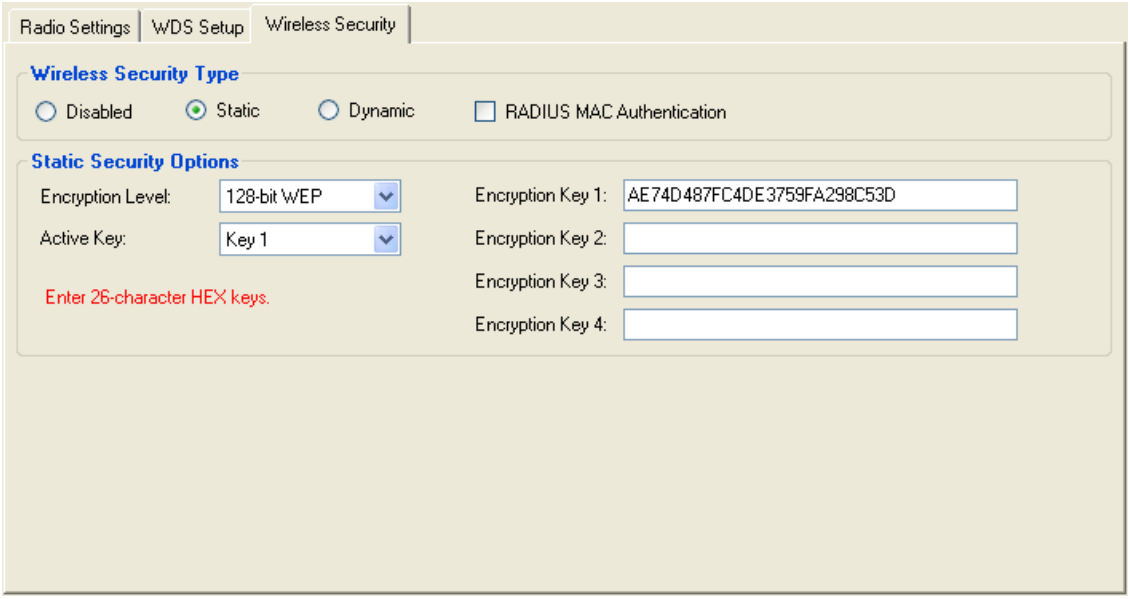
Static Security Settings

The following screen shot shows the static security options for a broadband radio:



The following table describes the static security options found in the Wireless Security Settings tab:

Static Security Options	
Field Name	**Description**
Encryption Level	Select the encryption level to use. Three options are available:

Option	Description
64-bit WEP	Uses a 40-bit encryption key coupled with a 24-bit initialization vector. This option is considered to be obsolete, and should only be used for compatibility with existing infrastructure.
128-bit WEP	Uses a 104-bit encryption key coupled with a 24-bit initialization vector. This option is more secure than 64-bit WEP, but still suffers from deficiencies in the WEP algorithm. It should only be used for compatibility with existing infrastructure.
128-bit AES	Uses the 128-bit AES block encryption algorithm couple with the CBC-MAC block chaining technique for added security. This is the most secure of the three static security options.

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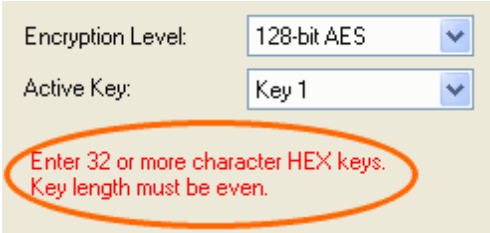
Active Key	Select the encryption key to use. Although you can define up to four static encryption keys, only one key can be active.
Encryption Key (1-4)	Enter the hexadecimal character sequence to use for the encryption key. Hexadecimal characters include the decimal digits (0-9) and the letters A-F. The number of characters you need to enter depends on the **Encryption Level** you have specified. An indicator, located below the **Active Key** list, will indicate the number of characters you have to enter: 

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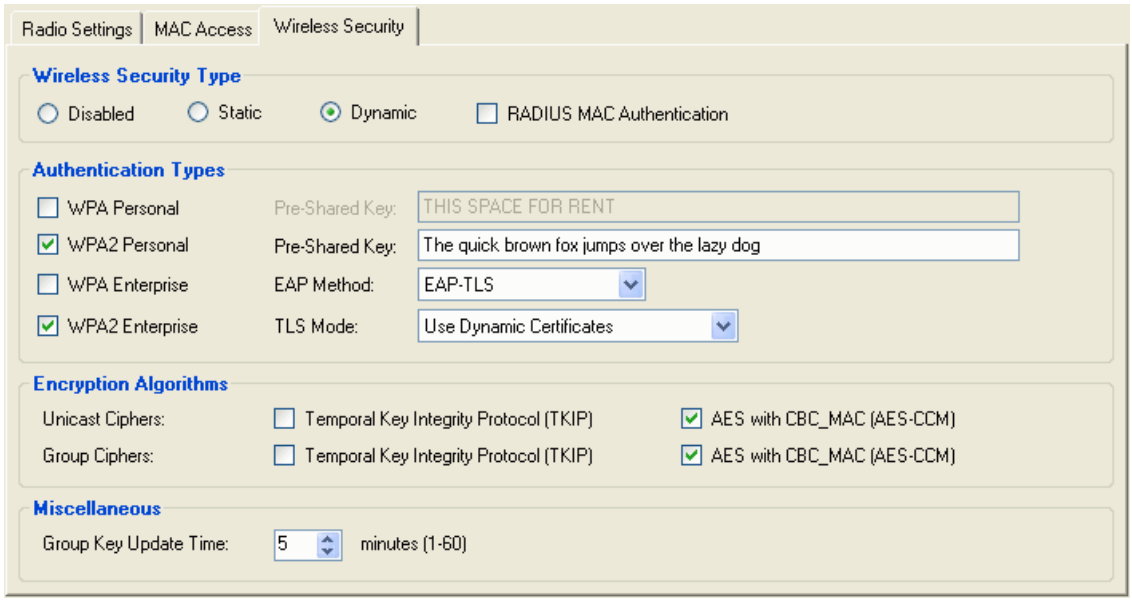
Dynamic Security Settings

The following screen shot shows the dynamic security options for a broadband radio:



The following tables describe the dynamic security options found in the Wireless Security Settings tab:

Authentication Types	
Field Name	**Description**
WPA Personal	Check this option to enable WPA personal authentication. You must also enter a pre-shared key used for the authentication process.
WPA2 Personal	Check this option to enable WPA2 personal authentication. You must also enter a pre-shared key used for the authentication process.
WPA Enterprise	Check this option to enable WPA enterprise authentication. This option does not require a pre-shared key.
WPA2 Enterprise	Check this option to enable WPA2 enterprise authentication. This option does not require a pre-shared key.

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<table>
<tr><th colspan="2">Authentication Types</th></tr>
<tr><th>Field Name</th><th>Description</th></tr>
<tr><td>EAP Method</td><td>Specify the authentication protocol to use. Two options are available:
<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td>Pass Through</td><td>Authentication requests are relayed to a RADIUS server.</td></tr>
<tr><td>EAP-TLS</td><td>TLS certificates are used for authentication.</td></tr>
</table>
This option is only used by the WPA Enterprise and WPA2 Enterprise authentication types. It is hidden if no enterprise option is selected.</td></tr>
<tr><td>TLS Mode</td><td>Specify how TLS certificates are to be used. Two options are available:
<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td>Use Dynamic Certificates</td><td>TLS certificates are negotiated dynamically using anonymous Diffie-Hellman MODP 2048 bit algorithm.</td></tr>
<tr><td>Use Imported Certificates</td><td>A TLS certificate that has been imported into the radio is used.</td></tr>
</table>
This option is only used when the EAP Method is set to EAP-TLS. It is hidden if the EAP-TLS option is not selected.</td></tr>
</table>

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Encryption Algorithms

Field Name	Description
Unicast Ciphers	Check the ciphers that can be used to encrypt frames sent to individual radios. Two options are available.

Option	Description
TKIP	Temporal Key Integrity Protocol. An encryption protocol that is compatible with legacy WEP equipment, but enhanced to correct some WEP flaws. This option should only be used for networks that contain legacy WEP devices.
AES-CCM	A more secure WPA encryption protocol, based on the reliable AES (Advanced Encryption Standard). Use this option is preferred if the there are no legacy WEP devices in the network.

Field Name	Description
Group Ciphers	Check the ciphers that can be used to encrypt frames broadcast to all radios. Two options are available.

Option	Description
TKIP	Temporal Key Integrity Protocol. An encryption protocol that is compatible with legacy WEP equipment, but enhanced to correct some WEP flaws. This option should only be used for networks that contain legacy WEP devices.
AES-CCM	A more secure WPA encryption protocol, based on the reliable AES (Advanced Encryption Standard). Use this option is preferred if the there are no legacy WEP devices in the network.

Miscellaneous

Field Name	Description
Group Key Update Time	The interval at which the dynamically generated keys are updated.

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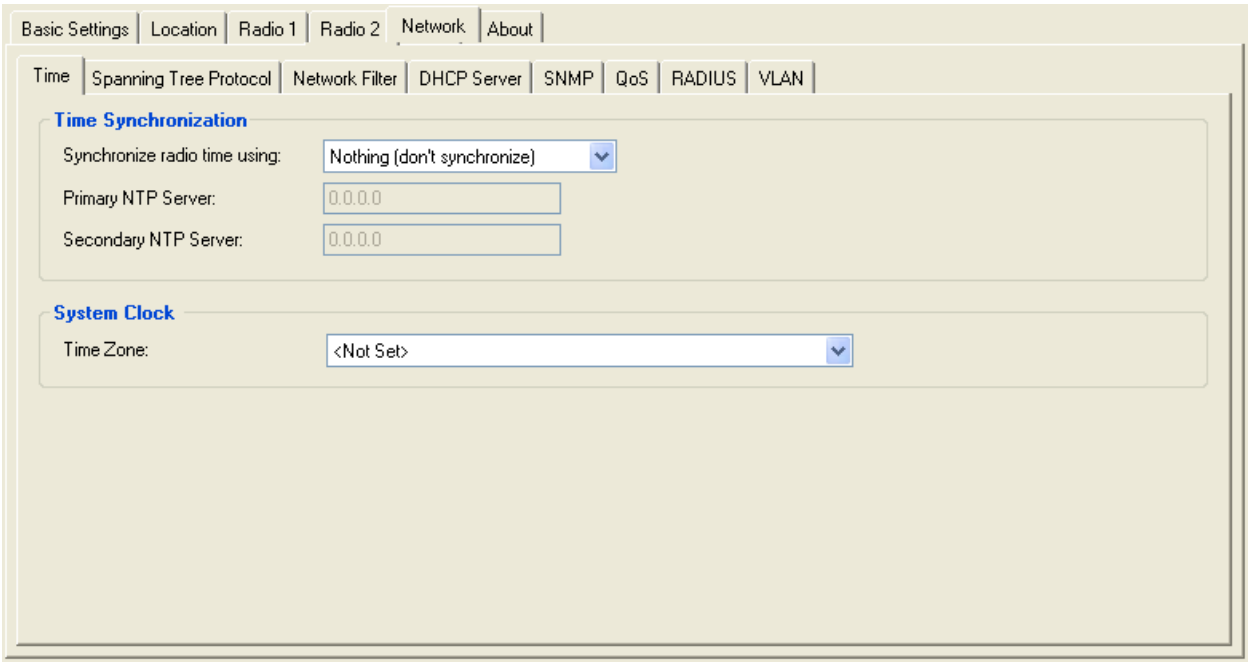
Network Tab

The following screen shot shows the network settings tab for a broadband radio:



Because a large number of configuration options are available, the network configuration tab is split up into a number of sub-tabs. The following topics describe the settings found in each sub-tab:

- Time Settings
- Spanning Tree Protocol Settings
- Network Filter Settings
- DHCP Server Settings
- SNMP Settings
- QoS (Quality of Service) Settings
- RADIUS Settings
- VLAN Settings

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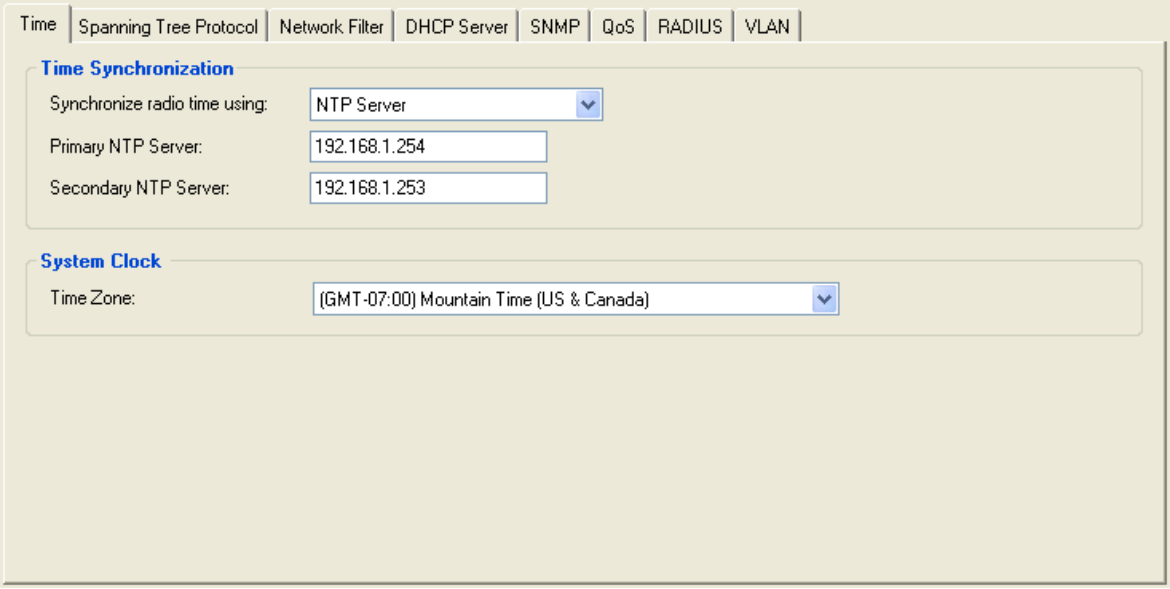
Time Settings

The following screen shot shows the *Time* settings tab for a broadband radio:



The following table describes the time settings.

<table>
<tr><th colspan="2">Time Synchronization</th></tr>
<tr><th>Field Name</th><th>Description</th></tr>
<tr><td>Synchronize radio time using</td><td>Select one of the following options to set the system clock:
<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td>Nothing</td><td>The radio's time will only be synchronized when a configuration change is made by STRATOS.</td></tr>
<tr><td>NTP Server</td><td>The radio will synchronize its internal clock to the specified NTP server time at regular intervals.</td></tr>
<tr><td>GPS Receiver</td><td>The radio will synchronize its internal clock from the built-in GPS receiver.
Note: This option is only available if the radio contains a GPS receiver.</td></tr>
</table></td></tr>
<tr><td>Primary NTP Server</td><td>Specify the IP address of the NTP server used to synchronize the radio's internal clock. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:</td></tr>
</table>

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	 Note: This option is only enabled when the **NTP Server** option is selected.
Secondary NTP Server	If applicable, specify the IP address of the secondary NTP server. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If there is no secondary NTP server in your network, enter "0.0.0.0" in this field. **Note:** This option is only enabled when the **NTP Server** option is selected.

System Clock	
Field Name	**Description**
Time Zone	Select the time zone in which the radio is operating. Note that the time zone has no effect on the operation of the radio, and does not need to be set for normal operation. If the time zone is not set, the radio defaults to UTC time.

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Spanning Tree Protocol Settings

The following screen shot shows the *Spanning Tree Protocol* settings tab for a broadband radio:

The spanning tree protocols are used to prevent the formation of loops that can interfere with the proper operation of the radio network. Refer to Appendix C: Spanning Tree Protocol for more information on the this subject, and for guidance in designing a radio network that uses STP or RSTP.

The following table describes the spanning tree protocol settings.

Spanning Tree Protocol	
Field Name	**Description**
Spanning Tree Protocol	The Spanning Tree Protocol (STP) is a protocol that provides link management to prevent undesirable loops from appearing in the network. You can select from one of the following options:

Option	Description
Disabled	STP is not enabled. This is the default setting.
STP	STP is enabled.
Rapid STP	Rapid STP is enabled. This is an enhanced version of the STP protocol that provides for faster spanning tree convergence after a topology change. You would normally use this option if you want to

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	use STP in your network.
Preferred Root	Check this option if you want the radio to be preferred over other radios when the network is negotiating which radio to use as the STP root.
Bridge Priority	The STP priority that is assigned to the radio. This setting is managed by STRATOS, and cannot be changed manually. This information can be useful if you have other STP or RSTP enabled devices in your network (such as switches and routers), and you need to configure them to interact with the ENCOM radios.

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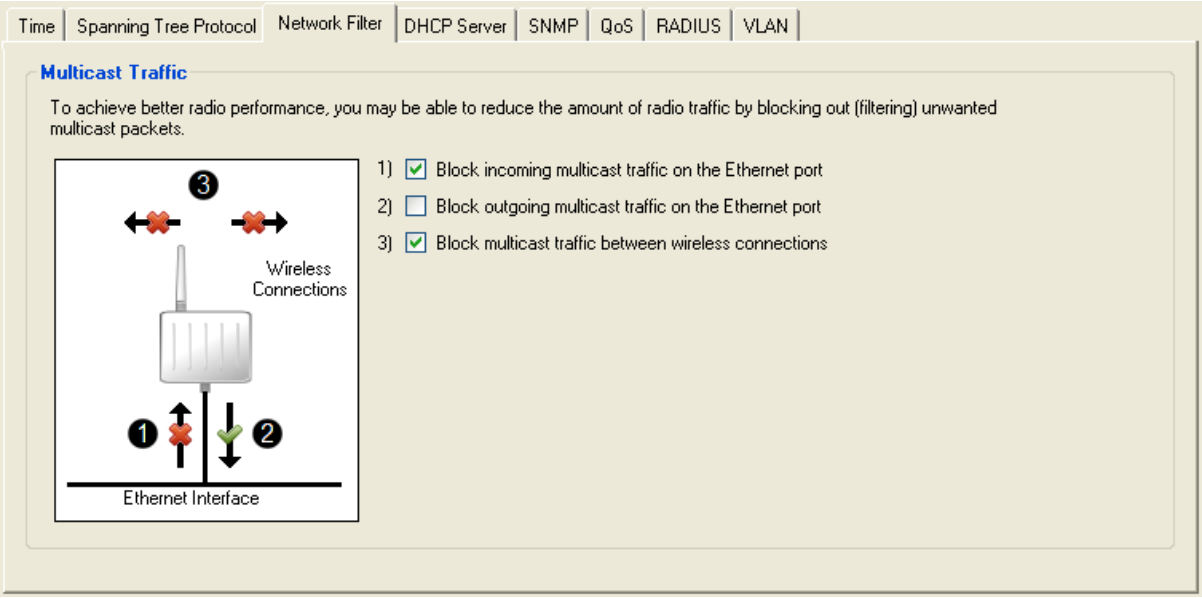
Network Filter Settings

The following screen shot shows the Network Filter tab for a broadband radio:


Time
Spanning Tree Protocol
Network Filter
DHCP Server
SNMP
QoS
RADIUS
VLAN
Multicast Traffic
To achieve better radio performance, you may be able to reduce the amount of radio traffic by blocking out (filtering) unwanted multicast packets.
1) Block incoming multicast traffic on the Ethernet port
2) Block outgoing multicast traffic on the Ethernet port
3) Block multicast traffic between wireless connections
Wireless Connections
Ethernet Interface

The network filters are used to block multicast traffic from being forwarded by the radio. This can enhance the performance of your radio network, by eliminating unnecessary network traffic.

The following table describes the network filter settings.

Network Traffic Filtering	
Field Name	**Description**
Block incoming multicast traffic on the Ethernet port	Check this option to prevent multicast traffic arriving on the radio's Ethernet port from being forwarded to the radio's wireless interfaces.
Block outgoing multicast traffic on the Ethernet port	Check this option to prevent multicast traffic arriving on the radio's wireless interfaces from being forwarded to the radio's Ethernet port.
Block multicast traffic between wireless connections	Check this option to prevent multicast traffic arriving on one of the radio's physical radio cards, WDS links or client wireless connections from being forwarded to the other radio cards, WDS links or client wireless connections.

Note that some network protocols (such as those used by traffic cameras) use multicast packets to operate. Because of this, you must be careful when disabling these settings.

Refer to Appendix F: Network Filters for more information on setting up the network filters.

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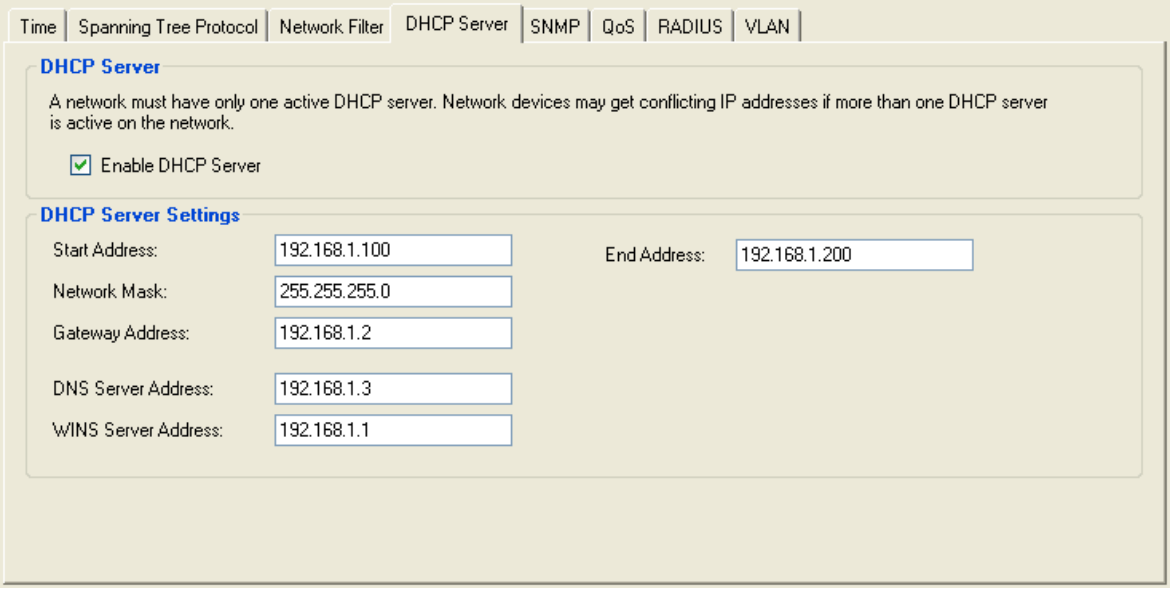
DHCP Server Settings

The following screen shot shows the DHCP server tab for a broadband radio:



The following tables describe the DHCP server settings.

DHCP Server	
Field Name	**Description**
Enable DHCP Server	Check this option to enable the radio's DHCP server. When this option is enabled, the radio will assign IP addresses to any other radio, or any other other device, that is configured to obtain their IP addresses dynamically. **Important:** Severe network instability can occur if there is more than one DHCP server present in a network or network segment. Do not enable this option if a router or another radio is already acting as a DHCP server.

DHCP Server Settings	
Field Name	**Description**
DHCP Address Range	Specify the start and end range of the IP addresses that will be provided by the DHCP server, as shown in the following example: DHCP Address Range: 192.168.1.100 to 192.168.1.200 In this example, IP addresses in the 192.168.1.100 - 192.168.1.200 range will be assigned to devices that use dynamic addressing. IP addresses outside this range would be manually assigned to devices that do not use dynamic addressing.

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DHCP Server Settings	
Field Name	**Description**
Network Mask	Enter the network mask that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:
Gateway Address	Enter the IP Address of the default gateway that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: The default gateway is the radio or router that provides access to devices outside of the local network.
DNS Server Address	Enter the IP Address of the DNS server that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If there is no DNS server available in your network, enter "0.0.0.0" in this field.
WINS Server Address	Enter the IP Address of the WINS server that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If there is no WINS server available in your network, enter "0.0.0.0" in this field.

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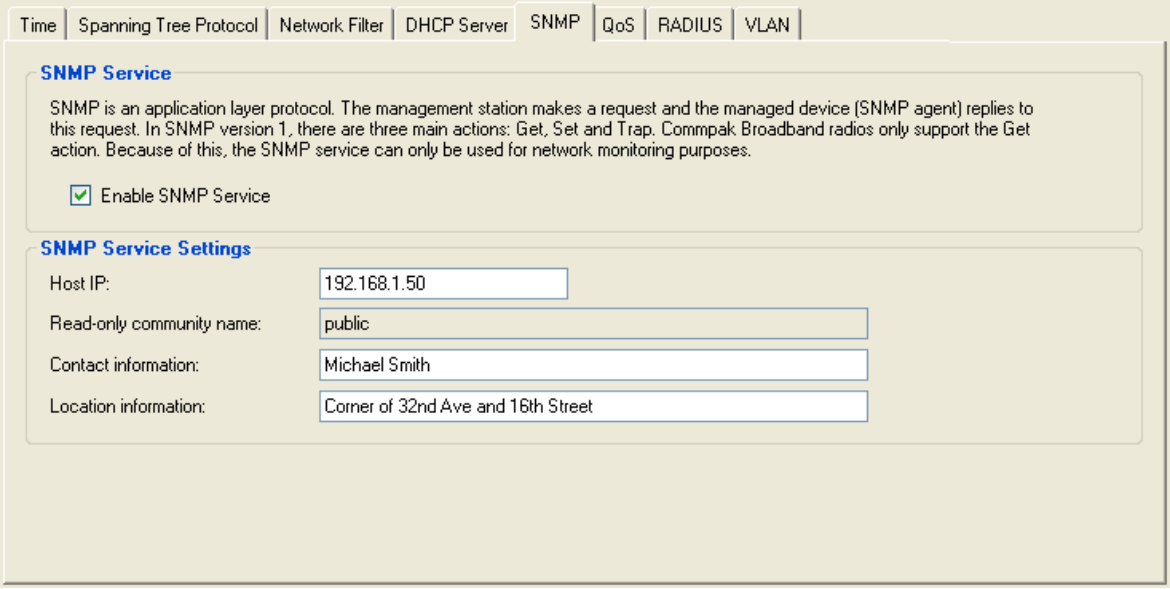
SNMP Settings

The following screen shot shows the SNMP tab for a broadband radio:


Time
Spanning Tree Protocol
Network Filter
DHCP Server
SNMP
QoS
RADIUS
VLAN
SNMP Service
SNMP is an application layer protocol. The management station makes a request and the managed device (SNMP agent) replies to this request. In SNMP version 1, there are three main actions: Get, Set and Trap. Commpak Broadband radios only support the Get action. Because of this, the SNMP service can only be used for network monitoring purposes.
Enable SNMP Service
SNMP Service Settings
Host IP:
192.168.1.50
Read-only community name:
public
Contact information:
Michael Smith
Location information:
Corner of 32nd Ave and 16th Street

The following tables describe the SNMP service settings.

SNMP Service	
Field Name	**Description**
Enable SNMP Service	Check this option enable the radio's SNMP (Simple Network Management Protocol) agent. When this option is enabled, diagnostic information can be obtained from the radio using any SNMP based network monitoring application.

SNMP Service Settings	
Field Name	**Description**
Host IP	Enter the IP address of the computer on which the network monitoring application is running, as shown in the following example: Setting this option will prevent any other computer from being able to access the radio's SNMP information. If you want to allow any computer that is on your network to access the radio's SNMP information, enter "0.0.0.0" in this field.
Community Name	The community name used to access the radio's SNMP agent. This is set

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	to 'public', and cannot be changed. Only read operations are permitted.
Contact Information	Enter the contact information of the individual responsible for the network, if applicable.
Location Information	Enter the location of the radio, if applicable.

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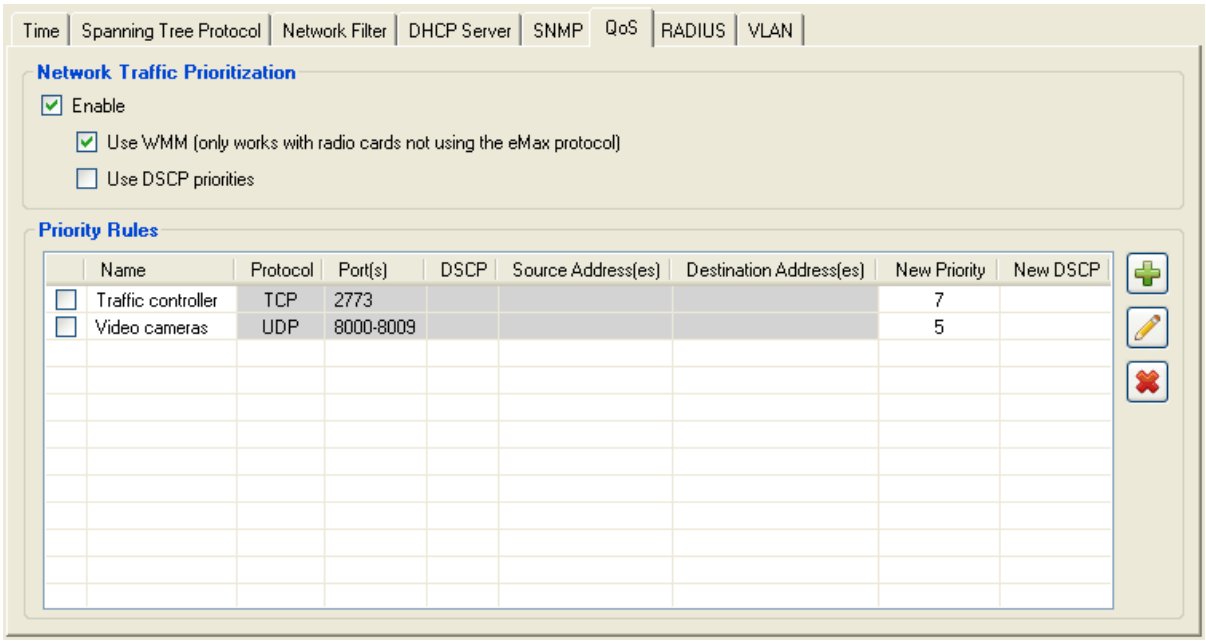
QoS Settings

The following screen shot shows the *QoS (Quality of Service)* settings tab for a broadband radio:



The Quality of Service settings allow you to prioritize the various types of network traffic so that important traffic is processed ahead of less important traffic.

Under normal conditions, all network data packets have an equal opportunity to be forwarded by the radio. This works well for some applications (such as file transfers or web browsing) but it is not adequate for traffic that is sensitive to network latency and throughput reductions (such as voice or video streaming). QoS allows you to address this issue by giving the time sensitive traffic a larger share of the network bandwidth.

Refer to Appendix D: Quality of Service for more detailed information on the prioritization mechanisms supported by the ENCOM radios.

The following tables describe the Quality of Service settings.

Network Traffic Prioritization	
Field Name	**Description**
Enable	Check this option to enable priority queue based QoS features. Priority rules are used to specify the priority of specific types of traffic. Lower priority traffic is dropped in preference to higher priority traffic when the radio becomes heavily loaded.
Use WMM	Check this option to set the priority of incoming packets to the incoming WMM priority (or to the incoming VLAN priority if VLANs are being used). WMM is used to prioritize certain type of traffic, such as VOIP (Voice Over

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	IP) and video streams, that are sensitive to network latency and capacity issues. **Note:** The WMM/VLAN priorities must be set by the device that creates the network data packets or by the router or switch that provides access to the ENCOM radio network.
Use DSCP Priorities	Check this option to set the priority of incoming packets to the DSCP priority of the incoming data packets. **Note:** The DSCP priorities must be set by the device that creates the network data packets or by the router or switch that provides access to the ENCOM radio network.

Priority Rules

Field Name	Description
Priority Rule List	By default, ENCOM STRATOS will assign the highest priority to the radio management traffic. Other types of network traffic can be assigned to specific priority queues by creating custom priority rules. The **Priority Rules** list displays the custom priority rules that you have defined. When defining a priority rule, you specify the type of traffic that the rule is to act upon, and the priority to assign to the matching traffic. In the following example, two priority rules have been defined:

	Name	Protocol	Port(s)	DSCP	Source Address(es)	Destination Address(es)	New Priority	New DSCP
☐	Traffic controller	TCP	2773				7	
☐	Video cameras	UDP	8000-8009				5	

The shaded cells contain the criteria that must be matched in order for a network data packet to be affected by the rule. Matching data packets will be assigned the **New Priority** (and optionally the **New DSCP** value) defined in the rule.

The priority rule list is sorted by the **New Priority** column, in descending order.

The following table describes the information that is displayed in the **Priority Rules** list:

Column	Description
☐	To delete a rule, first check it, and then click on the **Remove** button at the right of the **Priority Rule** list to actually delete it.

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<table>
<tr><td></td><td>
<table>
<tr><td>Name</td><td>A short description that identifies the type of network traffic associated with the rule.</td></tr>
<tr><td>Protocol</td><td>The protocol to match.</td></tr>
<tr><td>Port(s)</td><td>The IP port or ports to match. If blank, traffic on any port is affected by the rule.</td></tr>
<tr><td>Source Address(es)</td><td>The address or addresses that the data packets must originate from.</td></tr>
<tr><td>Destination Address(es)</td><td>The address or addresses that the data packets are being forwarded to.</td></tr>
<tr><td>DSCP</td><td>The DSCP value of the incoming packets to match. If blank, the DSCP priority is ignored by the rule.</td></tr>
<tr><td>New Priority</td><td>The priority to assign to the packets that match the specified criteria.</td></tr>
<tr><td>New DSCP</td><td>The DSCP value to assign to the packets that match the specified criteria.</td></tr>
</table>
</td></tr>
<tr><td>
(Add button)</td><td>Click the Add button to create a new priority rule. Enter the appropriate rule settings in the QoS Priority Rule form that is displayed.</td></tr>
<tr><td>
(Edit button)</td><td>Select a priority rule, and then click on the Edit button to modify the rule settings.
Alternatively, you can double-click on the rule you want to modify.</td></tr>
<tr><td>
(Remove button)</td><td>To delete a rule, first check it, and then click on the Remove button to actually delete it.</td></tr>
</table>

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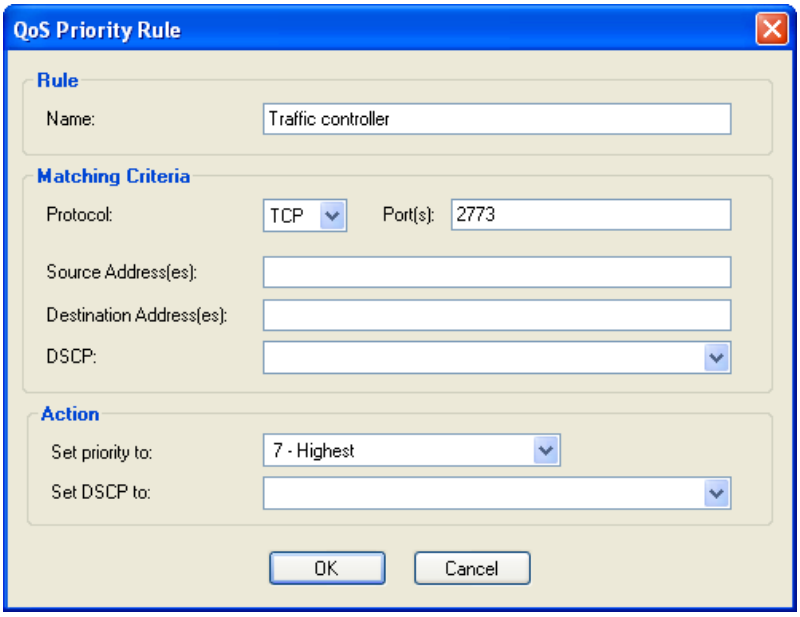
Specifying a QoS Priority Rule

The following screen shot shows the *QoS Priority Rule* form for a broadband radio:



The *QoS Priority Rule* form allows you to define a traffic priority rule.

The following tables describe the QoS rule settings.

Rule	
Field Name	**Description**
Name	Enter a short description that identifies the type of network traffic associated with the rule.

Matching Criteria	
Field Name	**Description**
Protocol	Specify the protocol that the rule will apply to. You can select one of the following values: **Protocol** / **Description** All / All network traffic will be matched. When you select this option, one or both of the **Source Address** and **Destination Address** fields must be set. Otherwise, all of the network traffic flowing through the radio would match the

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<table>
<tr><td></td><td>
<table>
<tr><td></td><td>rule.</td></tr>
<tr><td>UDP</td><td>The rule will only affect UDP traffic.</td></tr>
<tr><td>TCP</td><td>The rule will only affect TCP traffic.</td></tr>
</table>
</td></tr>
<tr><td>Ports</td><td>Optionally specify the port or ports associated with the network traffic that the rule will apply to. You can specify the ports using one of the following formats:
<table>
<tr><th>Format</th><th>Example</th></tr>
<tr><td>Single Port</td><td>1000</td></tr>
<tr><td>Multiple Ports</td><td>1000,2000</td></tr>
<tr><td>Port Range</td><td>1000-2000</td></tr>
<tr><td>Multiple Port Ranges</td><td>1000-2000,3000-4000</td></tr>
</table>
If this value is not specified, the rule will apply to all traffic of the selected protocol type.</td></tr>
<tr><td>Source Address(es)</td><td>Optionally specify the address or addresses that the data packets must originate from. You can specify the addresses using one of the following formats:
<table>
<tr><th>Format</th><th>Example</th></tr>
<tr><td>Single IPV4 Address</td><td>192.168.1.100</td></tr>
<tr><td>IPV4 Address Range</td><td>192.168.1.100-192.168.1.200</td></tr>
<tr><td>IPV4 CIDR Subnet</td><td>192/168.1.1/24</td></tr>
</table>
If this value is not specified, the rule will apply to all destination addresses.</td></tr>
<tr><td>Destination Address(es)</td><td>Optionally specify the address or addresses that the data packets are being forwarded to. You can specify the addresses using one of the following formats:
<table>
<tr><th>Format</th><th>Example</th></tr>
<tr><td>Single IPV4 Address</td><td>192.168.1.100</td></tr>
</table></td></tr>
</table>

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	<table><tr><td>IPV4 Address Range</td><td>192.168.1.100-192.168.1.200</td></tr><tr><td>IPV4 CIDR Subnet</td><td>192/168.1.1/24</td></tr></table> If this value is not specified, the rule will apply to all destination addresses.
DSCP	Optionally specify the DSCP (Differentiated Services Code Point) value in the IP header that the rule will apply to. You can select a predefined DSCP value from the drop-down list, or enter a number between 0 and 63. If this value is not specified, the rule will apply to all DSCP values.

Action	
Field Name	**Description**
Set priority to	The priority to assign to the packets that match the specified criteria. The higher the priority value, the higher the priority assigned to the associated network traffic.
Set DSCP to	Optionally specify the DSCP (Differentiated Services Code Point) value to assign to the packets that match the specified criteria. You can select a predefined DSCP value from the drop-down list, or enter a number between 0 and 63. If this value is not specified, no change will be made to the packet's DSCP value.

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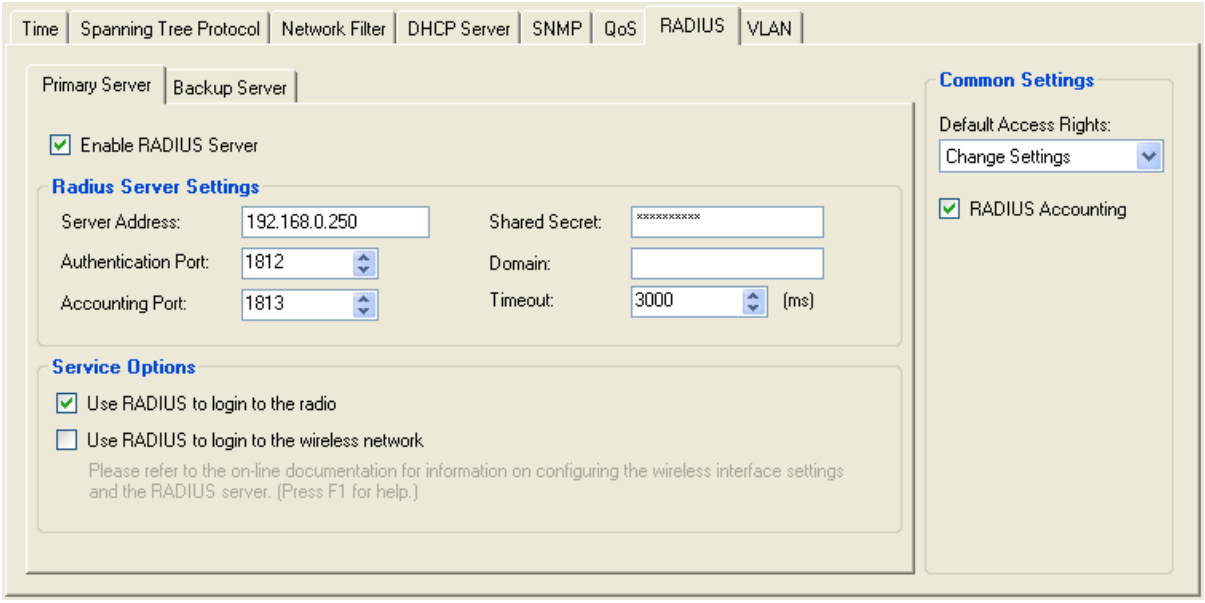
RADIUS Settings

The following screen shot shows the *RADIUS* settings tab for a broadband radio:



RADIUS is used to centralize the authentication of users that attempt to login to the radio and/or to the network. Refer to **ENCOM STRATOS RADIUS Configuration Guide**, available separately, for more information on setting up and using a RADIUS server with your radio network.

The following tables describe the settings found in each group in the RADIUS settings tab.

Primary and Secondary Server	
Field Name	**Description**
Enable RADIUS Server	Check this setting to enable the associated RADIUS server (Primary or Backup). If the radio cannot connect to the primary RADIUS server, it will attempt to connect to the backup RADIUS server.
Server Address	Enter the IP address of the RADIUS server.
Authentication Port	Enter the IP port on which RADIUS authentication requests are accepted. The default is 1812.
Accounting Port	Enter the IP port on which RADIUS accounting updates are accepted. The default is 1813.
Shared Secret	Enter a string that is used to obfuscate the user password that is sent to the RADIUS server for authentication. This value must match the Shared Secret that is configured in the RADIUS server.

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Domain	Enter the Microsoft Windows domain of the user. Only use if the RADIUS server requires domain validation.
Timeout	Enter the maximum amount of time (in milliseconds) to wait for a response from the RADIUS server before resending an authentication request. The default is 300 ms. You may need to increase this if your RADIUS server is slow to respond to authentication requests.
Use RADIUS to login to the radio	Check this option to use RADIUS to authenticate radio login requests. When this option is enabled, the radio will check with the RADIUS server if it does not find the specified user in its local user database.
User RADIUS to login to the wireless network	Check this option to use RADIUS to authenticate client devices that wish to attach to your network (e.g. for access to the network operations center or to your corporate LAN). If you select this option, you will need to check the RADIUS MAC Authentication setting for each of the radio cards that clients will use to connect to the network.

Common Settings

Field Name	Description
Default Access Rights	Select the access rights to assign to the user if the RADIUS server is not configured to respond to an authentication request with the user's group name. The following table describes the options that are available for this setting: **Option** / **Description** View Settings — The user will be able to inspect the radio's configuration settings, but will not be able to make any changes. Change Settings — The user will be able to inspect and change the radio's configuration settings. This setting is ignored if the RADIUS server responds to an authentication request with the user's group name.
RADIUS Accounting	Check this option to send RADIUS accounting packets to the RADIUS server. This information is normally used for user billing, and is not usually needed for typical ENCOM radio networks.

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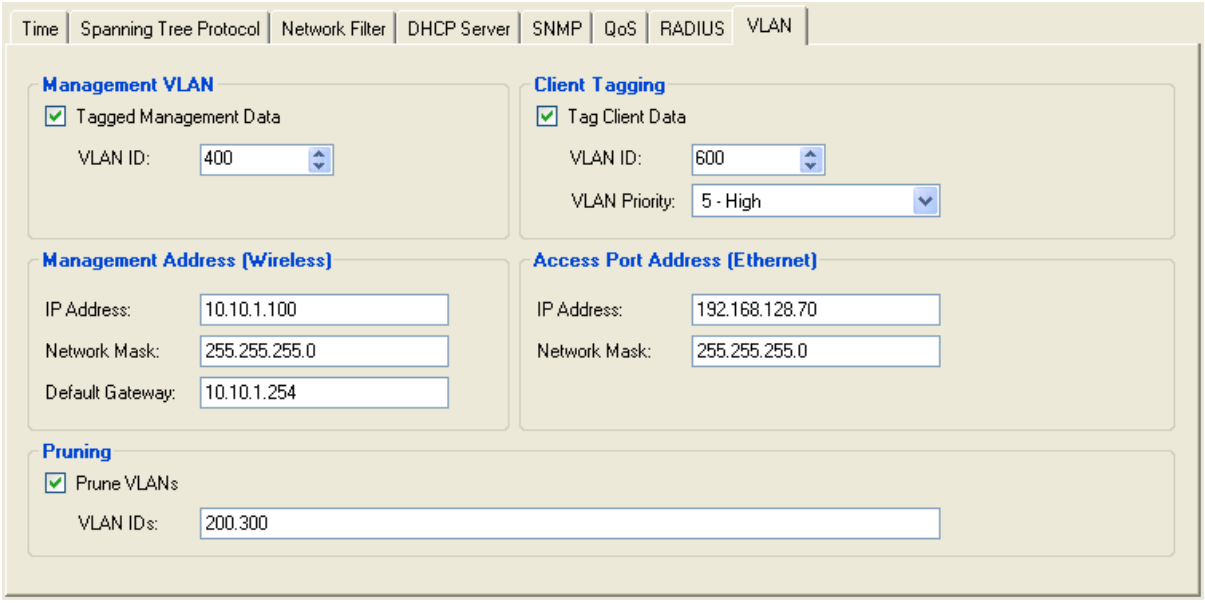
VLAN Settings

The following screen shot shows the *VLAN* settings tab for a broadband radio:



VLANs (Virtual LANs) are used to improve the performance, and possibly the security, of a radio network. Refer to Appendix E: VLAN Support for more information on implementing a VLAN-based network.

The following tables describe the settings found in each group in the VLAN settings tab.

Management VLAN	
Field Name	**Description**
Tagged Management Data	By default, the radio can be managed by connections over the native (non-tagged) VLAN. To be able to manage the radio using a specific VLAN, check this option, and enter the appropriate management VLAN ID in the **VLAN ID** field.
VLAN ID	Enter the ID of the management VLAN (a number in the range 1-4095 is required).

Client Tagging	
Field Name	**Description**
Tag Client Data	Normally, all of the radio's interfaces (wireless and Ethernet) act as VLAN trunks (i.e. they carry the network traffic for all VLANs). If a normal, non-VLAN aware device is plugged into the radio's Ethernet port, its network traffic will not be tagged, and it will not be able to communicate with

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	devices that are part of a VLAN. Check this option to set up the radio's Ethernet port as an access port for a specific VLAN. This gives devices connected to the Ethernet port access to the other devices in the specified VLAN.
VLAN ID	Enter the ID of the client VLAN to (a number in the range 1-4095 is required).
VLAN Priority	The priority to assign to the packets originating from the Ethernet port. The higher the priority value, the higher the priority assigned to the associated network traffic. **Note:** In order to prioritize the wireless network traffic using the VLAN priority, the appropriate QoS options need to be configured. See the Using WMM to Support VLAN Priority Traffic topic for more information.

Management Address (Wireless)

Field Name	Description
IP Address	Enter the IP address used to access the radio via its wireless interfaces. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tagged Management Data** option is checked, this IP address should be compatible with the management VLAN's network address range.
Network Mask	Enter the network mask of the network used to access the radio via its wireless interfaces. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tagged Management Data** option is checked, this mask should be compatible with the management VLAN's network mask.

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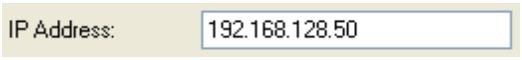
Default Gateway	Enter the IP address of the radio, router or switch that allows this radio to connect with devices that are outside of their local LAN or VLAN. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tagged Management Data** option is checked, this IP address would normally be the IP address of the network's gateway radio, or the IP address of the router or switch used to access external networks.

Access Port Address (Ethernet)	
Field Name	**Description**
IP Address	Enter the IP address used to access the radio via its Ethernet interface. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:  If the **Tag Client Data** option is checked, this IP address should be compatible with the client VLAN's network address range.
Network Mask	Enter the network mask of the network used to access the radio via its Ethernet interface. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tag Client Data** option is checked, this mask should be compatible with the client VLAN's network mask.

Pruning	
Field Name	**Description**
Prune VLANs	Check this option to prevent the radio for forwarding network traffic associated with specific VLAN IDs.
VLAN IDs	Enter one or more VLAN IDs to prune. Separate individual IDs with commas. Any incoming network traffic that matches the specified VLAN IDs will be dropped by the radio.

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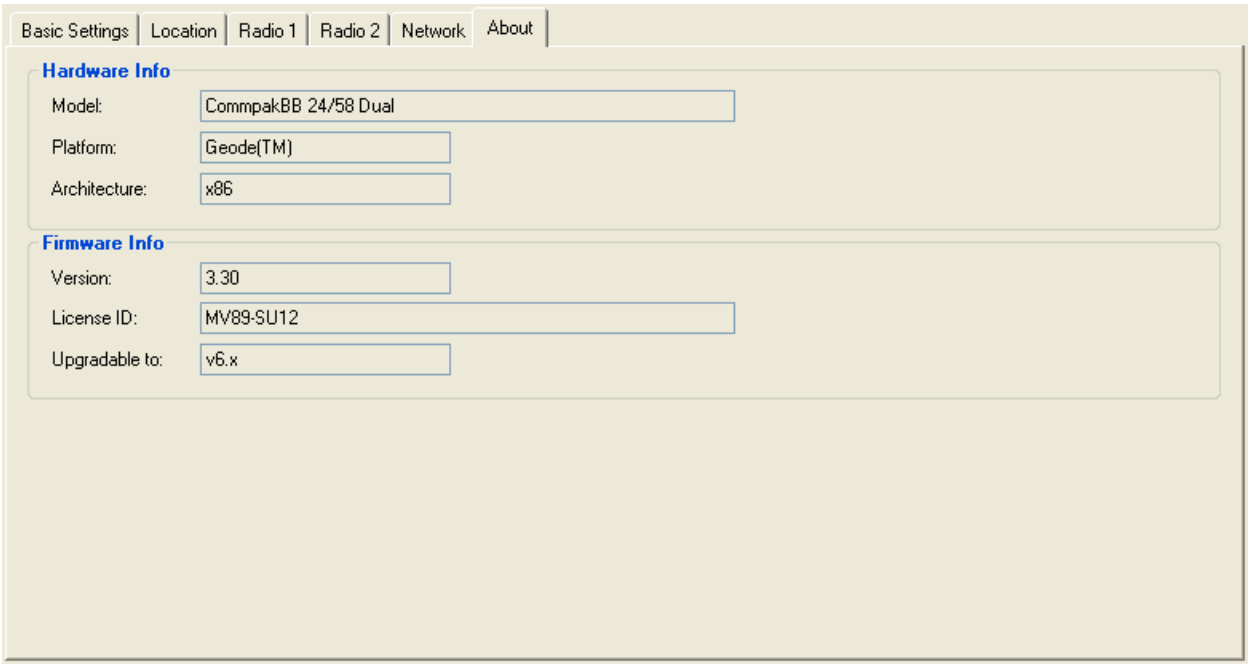
About Tab

The following screen shot shows the About tab for a broadband radio:



This tab displays information regarding the radio's hardware and firmware. It does not contain any user editable fields.

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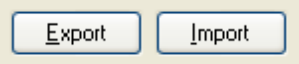
Export and Import Buttons

The **Export** and **Import** buttons in the lower left-hand corner of the radio configuration form allow you to save the radio's configuration settings to a file, and to update the radio's configuration settings from a previously saved configuration file.



Refer to the following topics for more information on these functions:

- Exporting the Radio Configuration
- Importing the Radio Configuration

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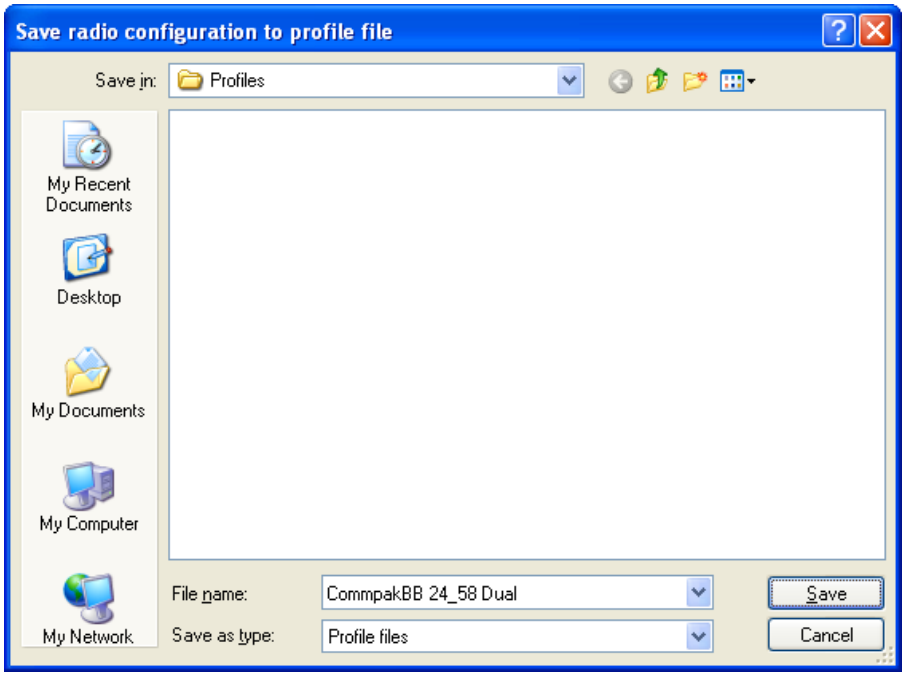
Exporting the Radio Configuration

The **Export** function is used to save the radio's current settings to a configuration profile file. This allows you to:

- Make a backup copy of the radio's configuration.
- Save the radio's configuration to a profile or template file for use in configuring other radios.

To export a radio's configuration:

1. From the radio's configuration form, click on the **Export** button. The *Save configuration profile file* form is displayed:



2. Specify the name of the file you want to save the radio's configuration settings to, and then press the **Save** button to save the settings.

   By default, STRATOS saves configuration profile files in the *'My Documents\Encom Wireless\Profiles'* folder.

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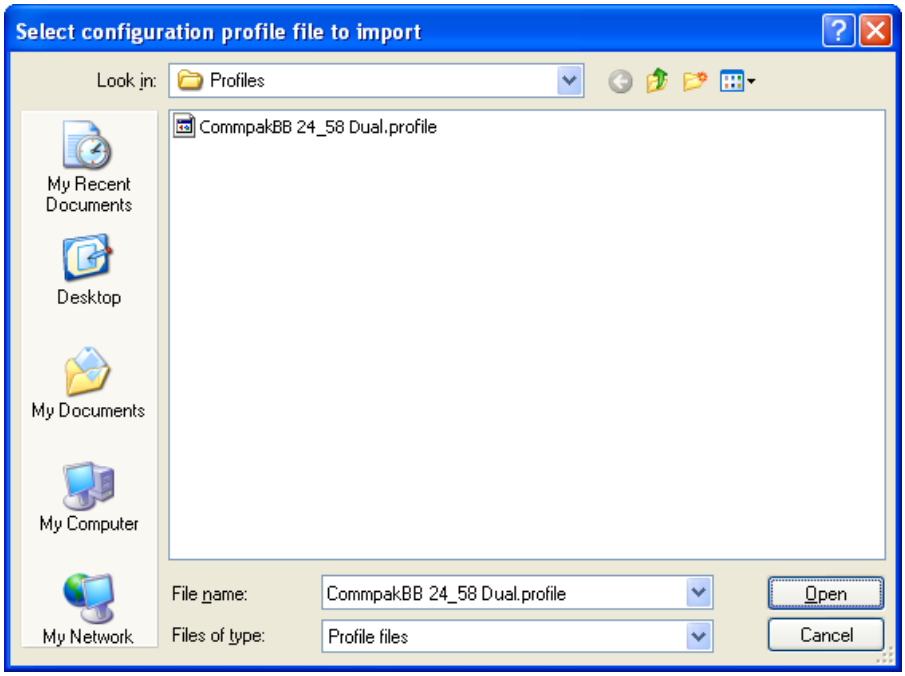
Importing the Radio Configuration

The **Import** function allows you to update the radio's settings from a previously saved configuration profile file. This function allows you to:

- Restore the radio's configuration from a backup file. This can be useful when you have to replace a radio in the field.
- Apply the settings from one radio to another. This can be used to provision new radios quickly, and ensure that they are compatible with other radios in the network.

To configure a radio using a saved configuration file:

1. From the radio's configuration form, click on the **Import** button. The *Select configuration profile file* form is displayed:



2. Select the configuration profile you want to import, and press the **Open** button.

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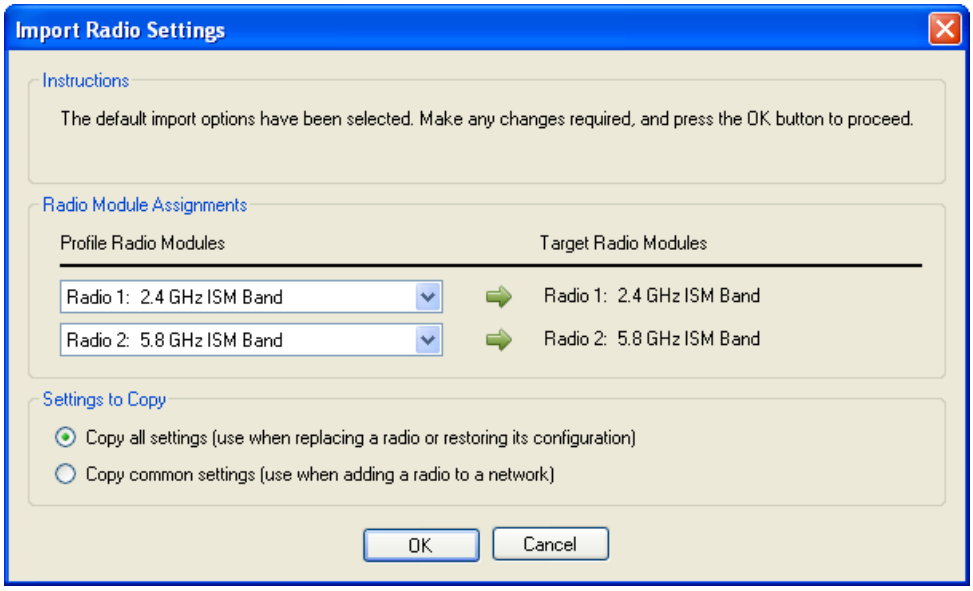
3. The *Import Radio Settings* form will be displayed:


Import Radio Settings
Instructions
The default import options have been selected. Make any changes required, and press the OK button to proceed.
Radio Module Assignments
Profile Radio Modules
Target Radio Modules
Radio 1: 2.4 GHz ISM Band
Radio 1: 2.4 GHz ISM Band
Radio 2: 5.8 GHz ISM Band
Radio 2: 5.8 GHz ISM Band
Settings to Copy
Copy all settings (use when replacing a radio or restoring its configuration)
Copy common settings (use when adding a radio to a network)
OK
Cancel

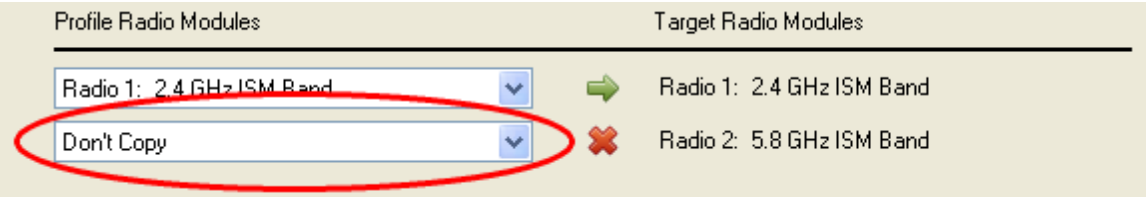
4. The *Radio Module Assignments* group allows you to specify how the radio module settings are applied:

Profile Radio Modules
Target Radio Modules
Radio 1: 2.4 GHz ISM Band
Radio 1: 2.4 GHz ISM Band
Radio 2: 5.8 GHz ISM Band
Radio 2: 5.8 GHz ISM Band

The **Target Radio Modules** column lists the wireless radio modules that are present on the radio.

The **Profile Radio Modules** column shows the options that are available for each wireless interface that is present on the radio. STRATOS will find the best match between the profile and target radio modules, and will assign these by default. You can change the default assignments by selecting the appropriate items from the list boxes.

In the example shown above, STRATOS applied the matching radio modules from the profile to the target radio modules. If you didn't want to disturb the configuration of the second radio module, then you would select the **Don't Copy** option from the second list box, as shown below:



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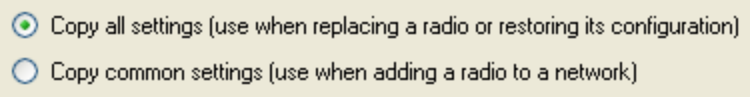
5. The **Settings to Copy** options allow you to specify what settings to import from the configuration profile:


Copy all settings (use when replacing a radio or restoring its configuration)
Copy common settings (use when adding a radio to a network)

These are described further in the following table:

Option	Description
Copy all settings	Use this option when you need to configure a radio so that it matches the configuration profile exactly. This option is most often used when configuring a replacement radio, or you want to restore the radio's configuration from a backup.
Copy common settings	Use this option to exclude those settings that are unique to the radio. This option is most often used when you are adding a new radio to a network, and you want to configure it to match the other radios in the network. The following items will **not** get copied over from the profile file to the radio: • Radio name • Radio Description • Radio latitude, longitude and street address • Radio static IP address • Parent radio MAC address • Static WDS assignments

6. Press the **OK** button to apply the profile settings to the radio.
7. Make any changes to the imported settings in the radio configuration form.
8. Press the **Save** button on the radio configuration form to save the settings to the radio.

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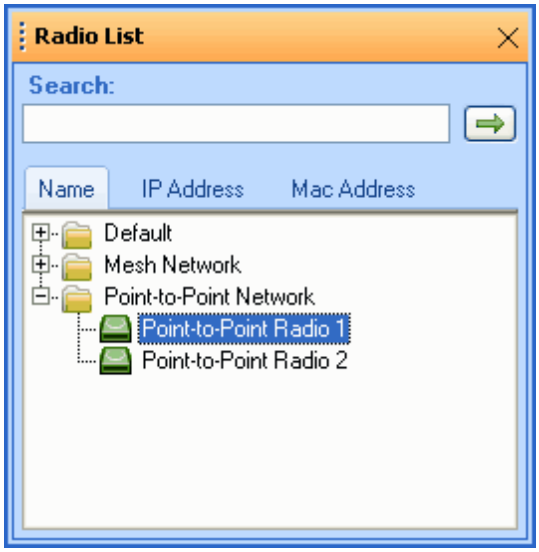
Configuring Point-to-Point Radios

To configure a point-to-point radio:

1. Locate the radio you would like to configure in the Radio List. Ensure that it is currently on-line (a green icon is displayed at the left of an on-line radio):



2. Click the right mouse button on the radio name, and select **Configure** from the pop-up menu that is displayed:

Alternatively, you can either double-click the left mouse button on the radio name, or click the left mouse button on the radio name, and select **Radio -> Configure** from the main menu.

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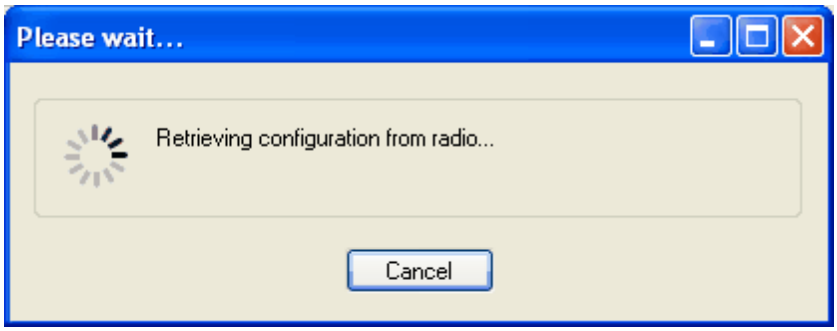
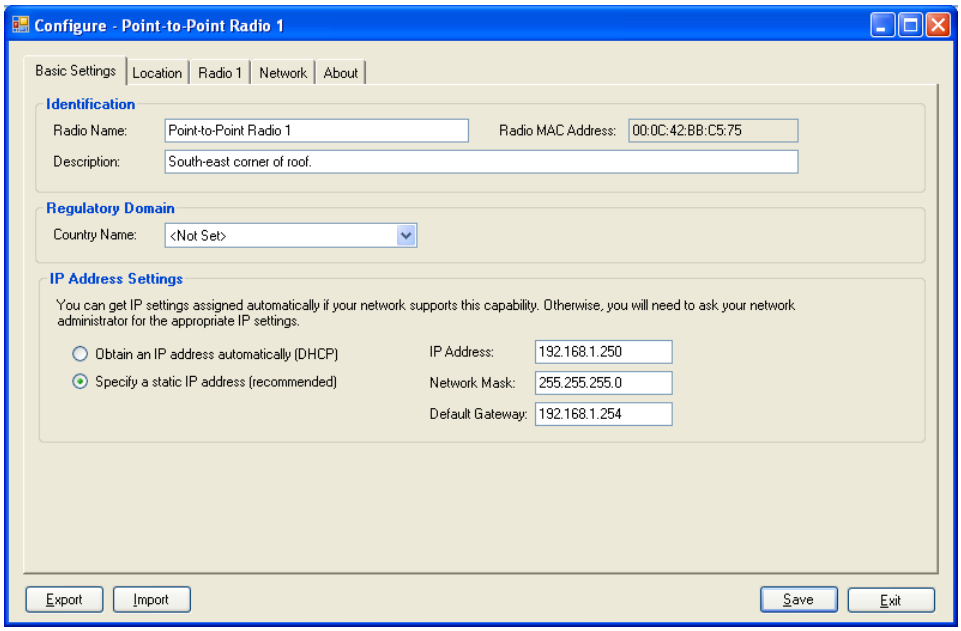
3. STRATOS will download the radio's current configuration. This process will normally take a few seconds to complete. During this time, a wait form is displayed:



4. When the radio's configuration has been obtained, the radio configuration form is displayed:



The configuration settings are logically grouped using a tabbed interface. The following topics describe the settings found in each tab:

- Basic Settings tab
- Location tab
- Radio tab
- Network tab
- About tab

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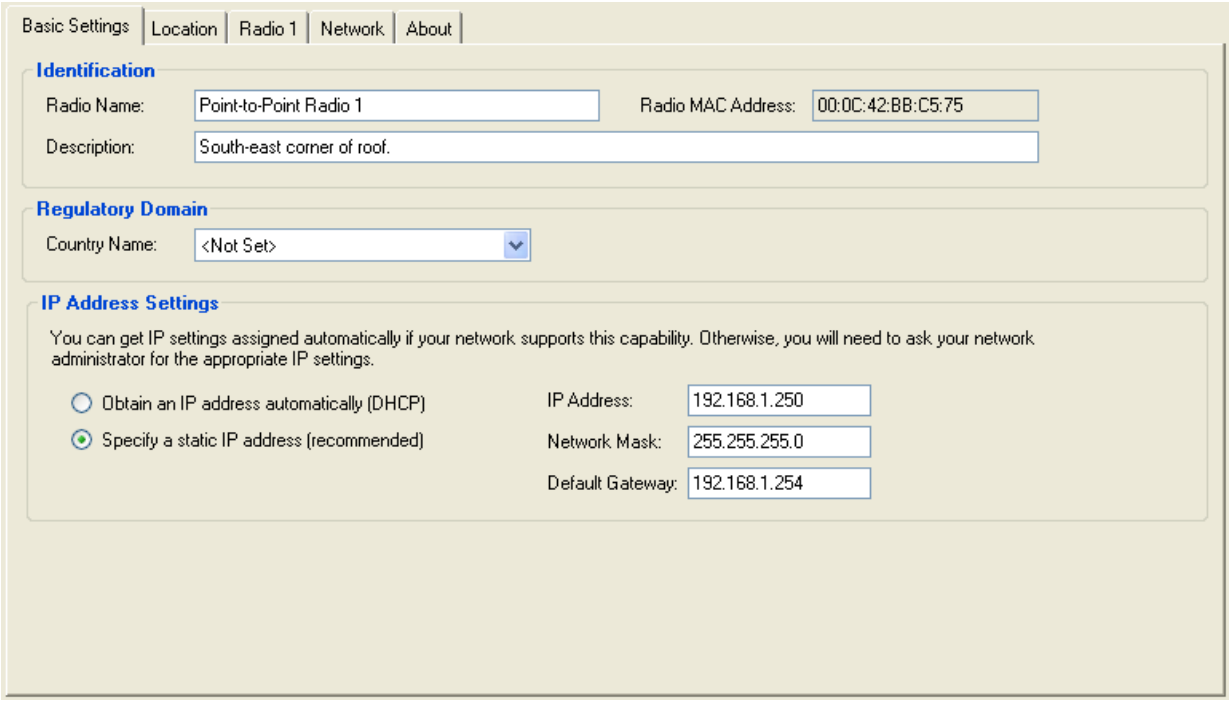
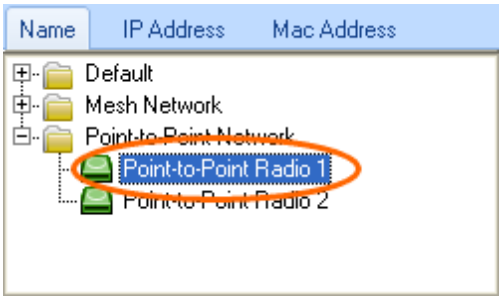
Basic Settings Tab

The following screen shot shows the basic configuration settings tab for a point-to-point radio:



The following tables describe the settings found in each group in the basic settings tab.

Identification	
Field Name	**Description**
Radio Name	Enter a name used to identify the radio (up to a maximum of 64 characters). The name you enter will be displayed in the radio list, and in all other places where a reference to the radio is made. 
Radio MAC Address	Displays the MAC address assigned to the radio. (This is essentially the MAC address of the radio's first Ethernet adapter.)

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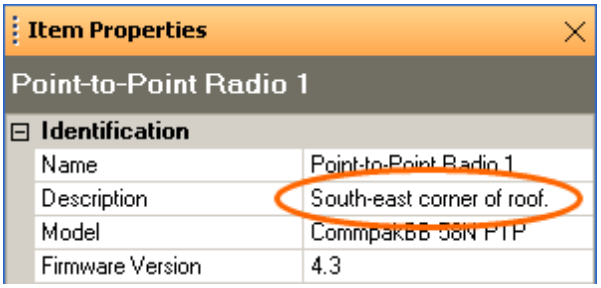
Identification	
Field Name	**Description**
Description	Enter an optional description for the radio. This field allows you to keep track of ad-hoc information associated with the radio, without adding clutter to the radio name. The radio description is displayed in the radio properties panel: 

Regulatory Domain	
Field Name	**Description**
Country Name	Select the country in which the radio is operating. Certain countries have limitations on the radio power output, allowed frequency ranges and frequency bands. Failure to select the appropriate country can result in a radio that is operating outside of the legally allowed ranges. If the radio is operating in the United States or Canada, you can leave this setting to **<Not Set>**.

IP Address Settings	
Field Name	**Description**
Obtain an IP address automatically	Select this option if a DHCP server is available on your radio network, and you want the DHCP server to assign an IP address to the radio.
Specify a static IP address	Select this option to manually assign the radio's IP address. ENCOM recommends this option because it provides for a more secure network (especially if you have not enabled wireless security). **Note:** It is important that each radio in the network is assigned a different IP address. Network performance can suffer greatly if two or more radios are assigned the same IP address.

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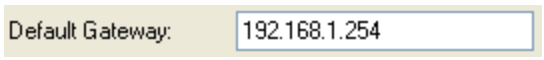
IP Address Settings	
Field Name	**Description**
IP Address	Enter the IP address of the radio. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:
Network Mask	Enter the network mask. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:
Default Gateway	Enter the IP address of the radio or router that allows the radio to connect with devices that are outside of their local LAN or VLAN. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:  Note that the default gateway's IP address must be in the same subnet as the radio's IP address.

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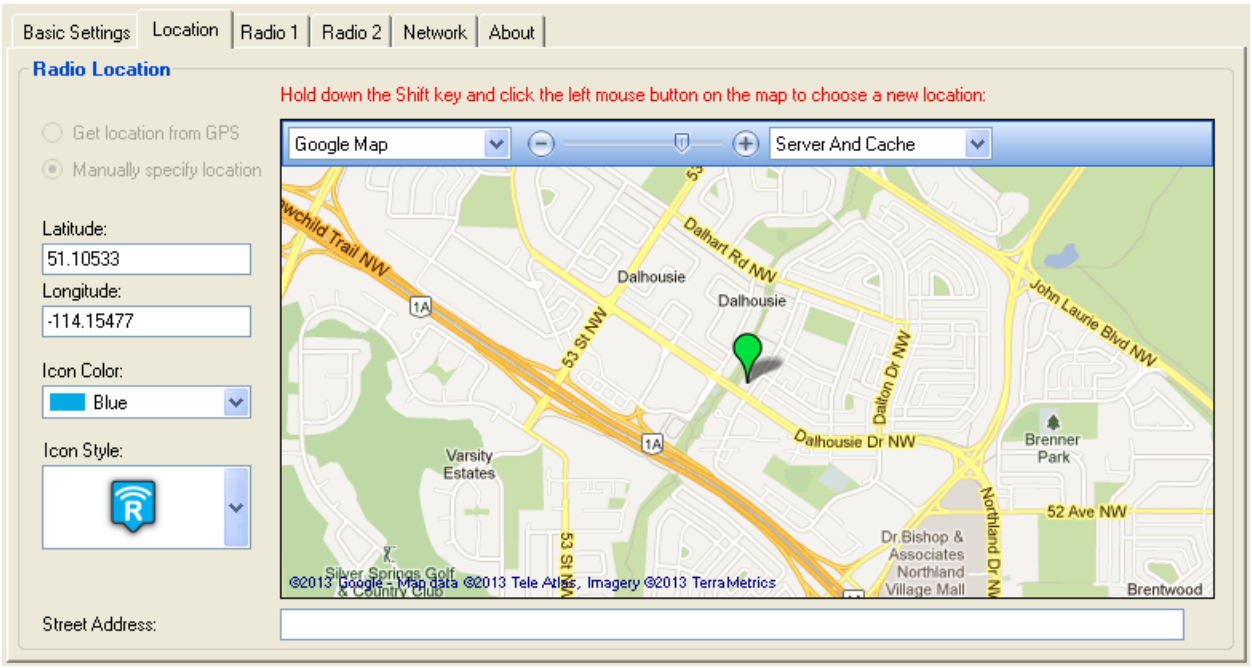
Location Tab

The following screen shot shows the location settings tab for a point-to-point radio:



The following table describes the settings found in the location tab.

Field Name	Description
Get location from GPS	Select this option if you want the radio to get its location from the built-in GPS receiver. This option is not available if the radio does not contain a GPS receiver.
Manually specify location	Select this option if you want to manually specify the location of the radio.
Latitude	Enter the latitude at which the radio is located, in decimal degrees. This value is positive in the northern hemisphere and negative in the southern hemisphere. Alternatively, hold down the Shift key and click the left mouse button on the map to set the radio's position. This process will automatically update the **Latitude** field.
Longitude	Enter the longitude at which the radio is located, in decimal degrees. This value is positive in the eastern hemisphere and negative in the western hemisphere. Alternatively, hold down the Shift key and click the left mouse button on the map to set the radio's position. This process will automatically update

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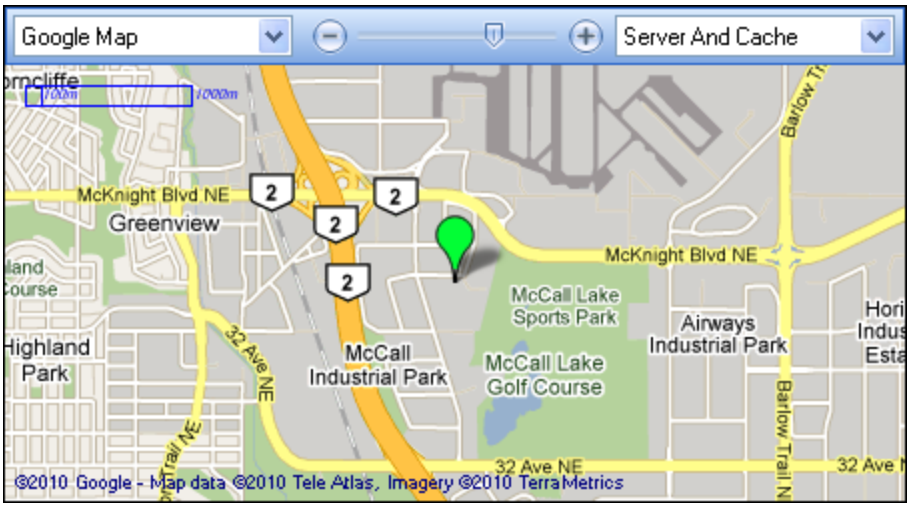
<table>
<tr><td></td><td>the Longitude field.</td></tr>
<tr><td>Icon Color</td><td>Select the color of the radio icon. You can use the icon color to visually group radios by radio type, geographical location, VLAN association, etc.</td></tr>
<tr><td>Icon Style</td><td>Select the style of the radio icon. Four icon styles are currently available:
<table>
<tr><th>Icon</th><th>Radio Type</th></tr>
<tr><td> </td><td>Generic radio</td></tr>
<tr><td> </td><td>Master radio</td></tr>
<tr><td> </td><td>Remote radio</td></tr>
<tr><td> </td><td>Repeater radio</td></tr>
<tr><td> </td><td>Dual radio</td></tr>
</table></td></tr>
<tr><td>Embedded map</td><td>The embedded map allows you to see the current location of the radio. A green marker shows the location assigned to the radio.


To set a new location:</td></tr>
</table>

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	• Press and hold down the Shift key on your computer's keyboard. • Click the left mouse button at the location you want to assign to the radio. • The green marker will move to the selected position. **Note:** Refer to the Map Panel topic for more information on the embedded map features.
Street Address	Enter the street address of the radio, if applicable. This information is optional.

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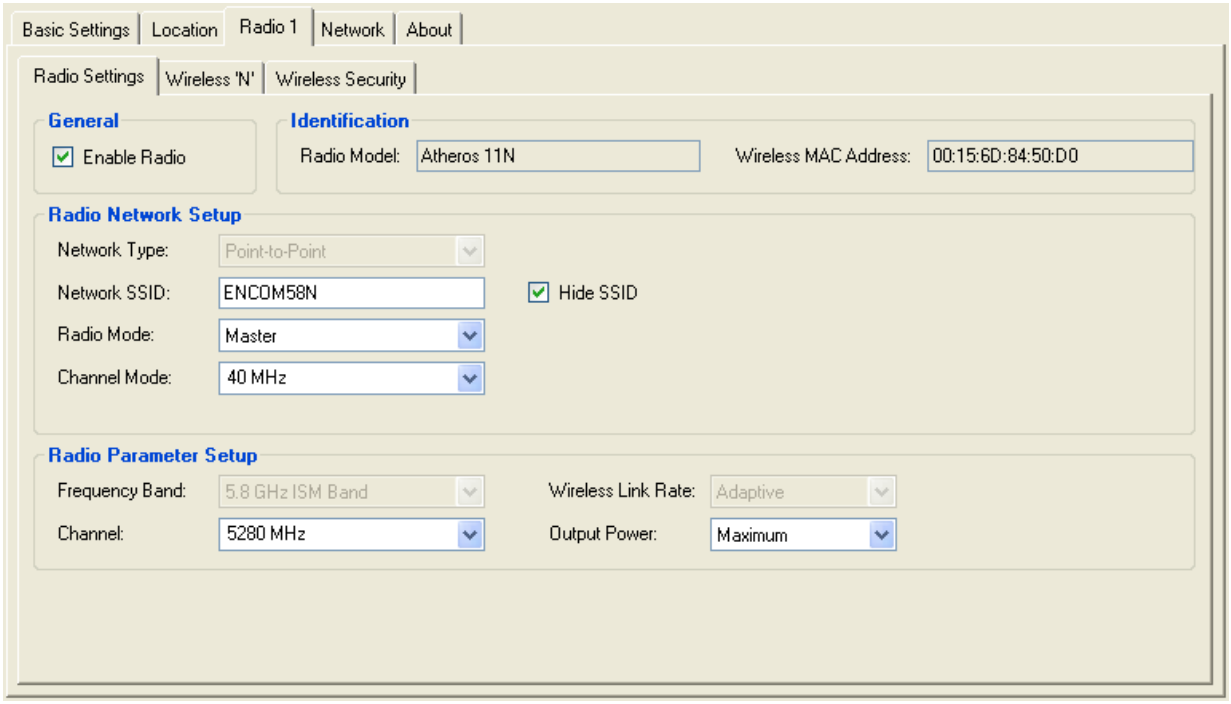
Radio Tab

ENCOM point-to-point radios contain a single wireless radio module. This module is configured in the **Radio 1** tab.

The following screen shot shows the radio settings tab for a point-to-point radio:



Because the wireless radio settings are somewhat involved, the radio configuration tab is split up into three sub-tabs. The following topics describe the settings found in each sub-tab:

- Radio Settings sub-tab
- Wireless 'N' sub-tab
- Wireless Security sub-tab

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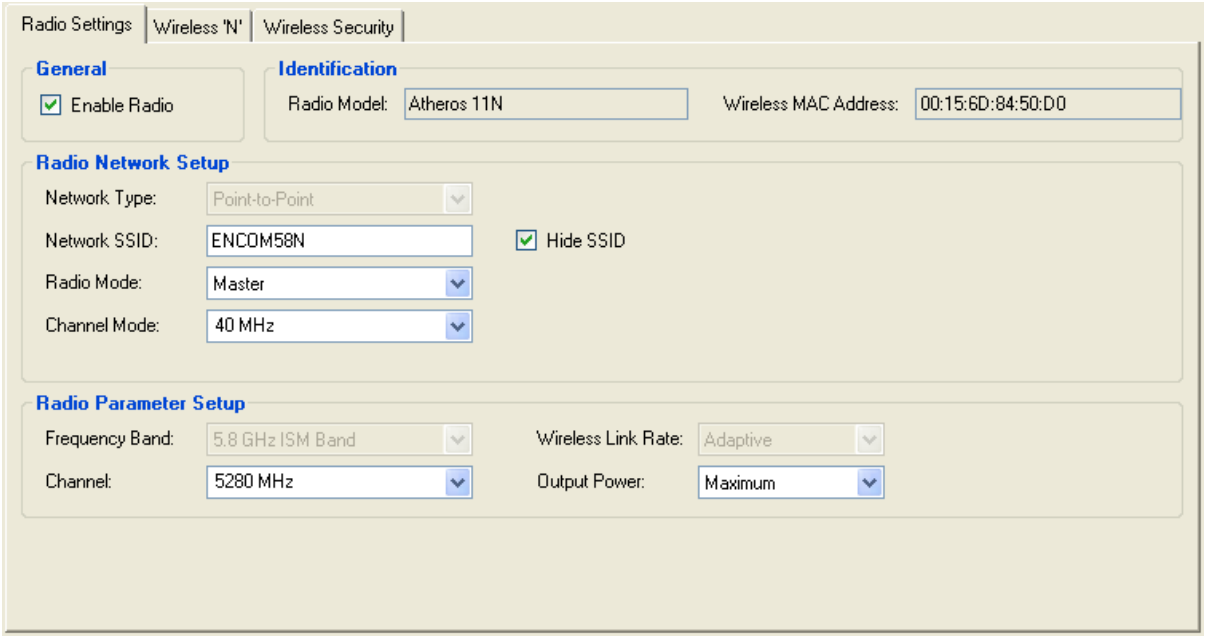
Radio Settings

The following screen shot shows the wireless radio settings tab for a point-to-point radio:



The following tables describe the settings found in each group in the wireless radio settings tab.

General	
Field Name	**Description**
Enable Radio	Uncheck this option to disable the wireless radio card. A disabled radio card will not be able to form wireless links with other radios. If you uncheck this option, all of the other options in the *Radio Settings* tab will be disabled.

Identification	
Field Name	**Description**
Radio Model	Displays the model number of the wireless radio card. This information is useful when troubleshooting issues with the radio.
Wireless MAC Address	Displays the MAC address assigned to the wireless radio card. For point-to-point radios, the MAC address of the wireless radio card is different than the MAC address of the radio's Ethernet interface.

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Radio Network Setup	
Field Name	**Description**
Network Type	Identifies the radio network type. This setting cannot be changed for point-to-point radios.
Network SSID	Enter a name used to identify the network in which the wireless radio will take part. The Network SSID is case sensitive, and may contain spaces. **Note:** You should change the default SSID assigned at the factory to a unique SSID for your network. You can minimize interference between adjacent networks by assigning a unique SSID for each network. **Important:** All radios that participate in the same network must be assigned the same Network SSID.
Hide SSID	Check this option to prevent the Network SSID from being broadcast by the wireless radio. This prevents external devices from being able to discover the network's SSID (and potentially connect to it).
Radio Mode	Select the radio mode based on the location of the radio with respect to the network operations center. Select the **Master** option for the radio that is located closest to the network operations center. This radio is usually connected to the network operation center via the Ethernet port. Select the **Remote** option for the remote radio.
Channel Mode	This option allows you to set the width of the frequency channel you are using. Selecting a smaller frequency for the **Channel Mode** increases the distance over which you can establish a wireless link, at the cost of reduced bandwidth. Since point-to-point radios are intended for use as high-capacity back-haul devices, a 40 MHz channel mode is recommended under normal circumstances.

Radio Parameter Setup	
Field Name	**Description**
Frequency Band	Displays the nominal frequency at which the radio operates. This option is set at the factory and cannot be changed.
Channel	Select the radio's operating frequency. **Note:** You can set the frequency of the master radio to a specific value.

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Radio Parameter Setup	
Field Name	**Description**
	Remote radios can only be set to *Auto-Frequency*, since they are designed to follow the frequency of the master radio.
Wireless Link Rate	Point-to-point radios use an adaptive algorithm to choose the best bit rate for the current link conditions. This setting is for your information only, and cannot be changed.
Output Power	Select the wireless radio's output power. Unless constrained by the Regulatory Domain that the radio is operating in, you should use the *Maximum* power setting when the radio is deployed in the field. If the radio is being provisioned or tested in a bench environment, you should use the *Low* power setting.

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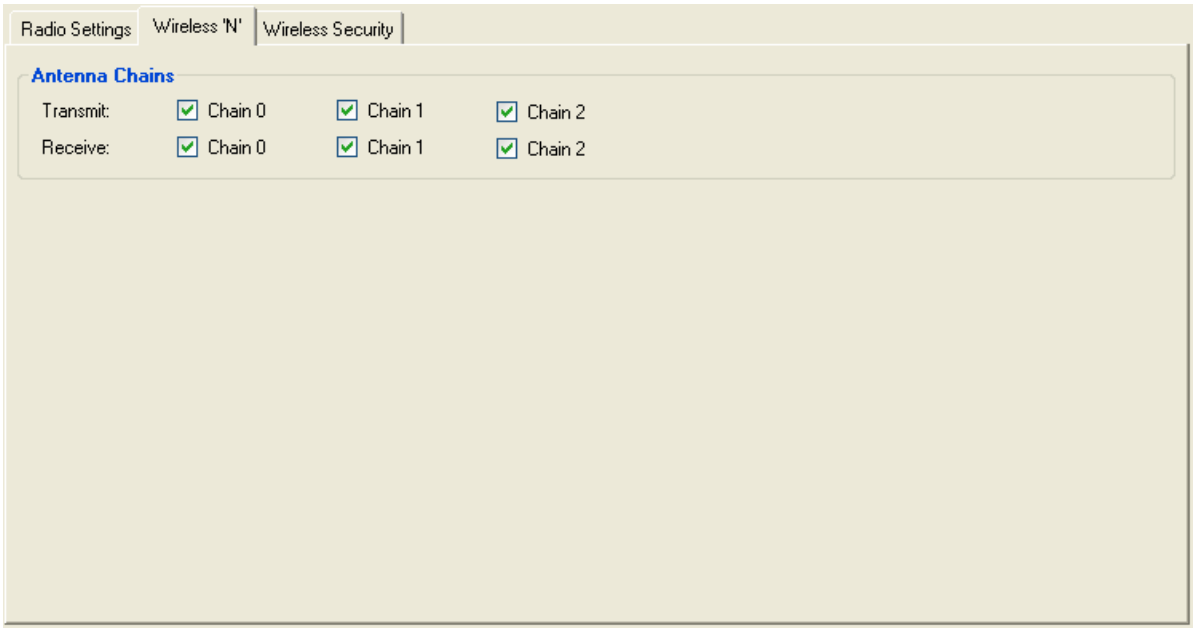
Wireless 'N' Settings

The following screen shot shows the wireless 'N' settings tab for a point-to-point radio:



ENCOM offers point-to-point radios that support up to 3 antennas. STRATOS will automatically display the number of antennas that are supported by your radio in the *Antenna Chains* group.

The following table describes the settings found in each group in the wireless 'N' settings tab.

Antenna Chains	
Field Name	**Description**
Transmit	Specify the antennas to use for transmitting data. Check the **Chain** option to enable the associated antenna, and uncheck it to disable the antenna. For optimal performance, you should enable all of the antennas supported by your radio.
Receive	Specify the antennas to use for receiving data. Check the **Chain** option to enable the associated antenna, and uncheck it to disable the antenna. For optimal performance, you should enable all of the antennas supported by your radio.

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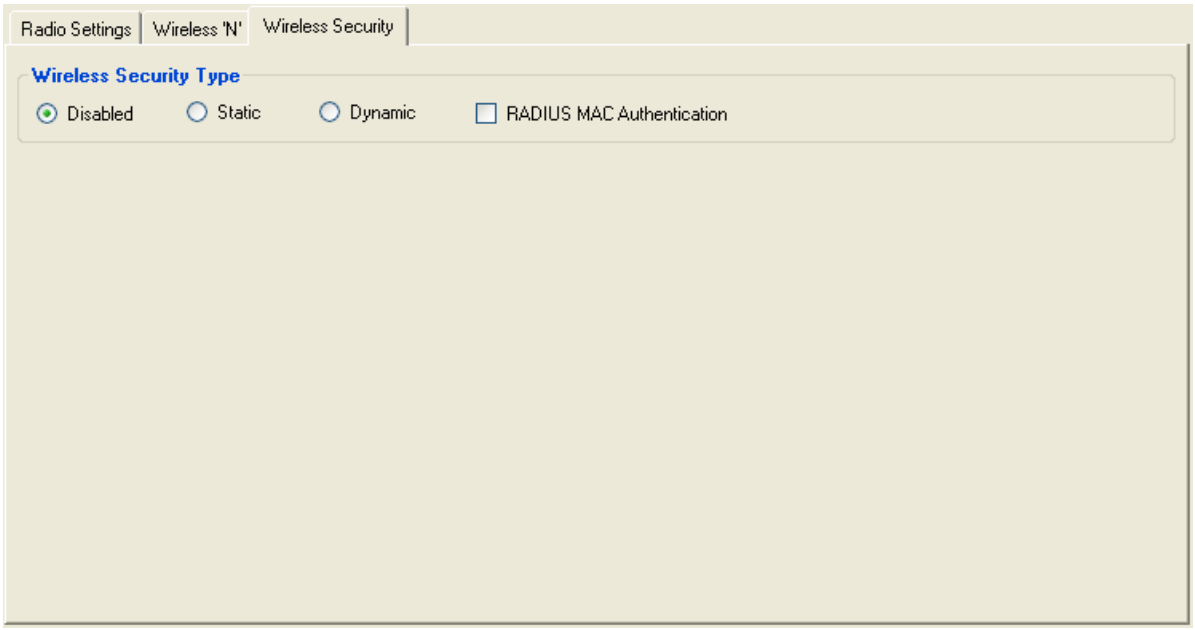
Wireless Security Settings

The following screen shot shows the wireless security settings tab for a point-to-point radio:



The Wireless Security Type group allows you to specify the security protocols used to protect the wireless communication links. You can choose from the following options:

Wireless Security Types	
Option	**Description**
Disabled	Select this option if you do not want to enable security. This option is not recommended since it allows anyone that has knowledge of the Network's SSID to connect to the network.
Static	This option enables wireless encryption that uses static keys. This is an older technology that is not as secure as the Dynamic option. It can, however, provide for a more stable network.
Dynamic	This option enables wireless encryption that uses dynamically allocated keys. This option provides the most secure communication link.
RADIUS MAC Authentication	Check this option if you use a RADIUS server for authentication. A Remote Authentication Dial in User Service (RADIUS) server acts as a centralized access and authorization point for network service. The authentication service is then handled by the RADIUS server instead of the ENCOM radios.

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Important: The security settings must be the identical for all radios on the network. Radios that have different security settings will not be able to communicate with each other.

Note: Encom Wireless Data Solutions highly recommends that you confer with your I.T. department to determine the appropriate level of security for your network.

The Static and Dynamic security options contain additional settings that need to be configured. The following topics describe these in more detail:

- Static Security Options
- Dynamic Security Options

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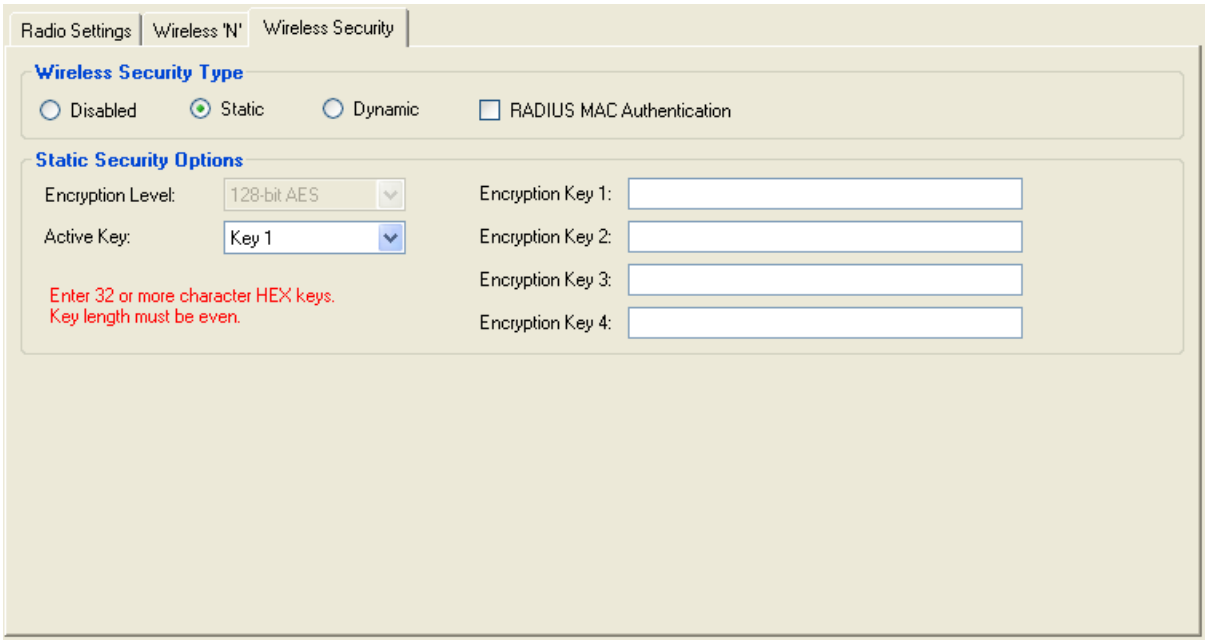
Static Security Settings

The following screen shot shows the static security options for a point-to-point radio:



The following table describes the static security options found in the *Wireless Security Settings* tab:

Static Security Options	
Field Name	**Description**
Encryption Level	Select the encryption level to use. Only one option is available for point-to-point radios. **Option** / **Description** 128-bit AES: Uses the 128-bit AES block encryption algorithm couple with the CBC-MAC block chaining technique for added security. This is the most secure of the three static security options.
Active Key	Select the encryption key to use. Although you can define up to four static encryption keys, only one key can be active.
Encryption Key (1-4)	Enter the hexadecimal character sequence to use for the encryption key. Hexadecimal characters include the decimal digits (0-9) and the letters A-F. The number of characters you need to enter depends on the **Encryption Level** you have specified. An indicator, located below the **Active Key** list,

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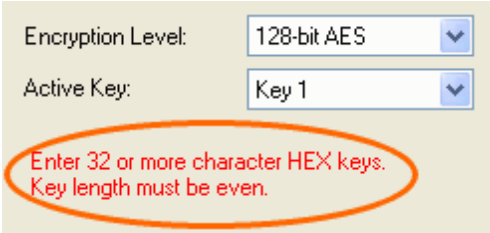
Static Security Options	
Field Name	**Description**
	will indicate the number of characters you have to enter: 

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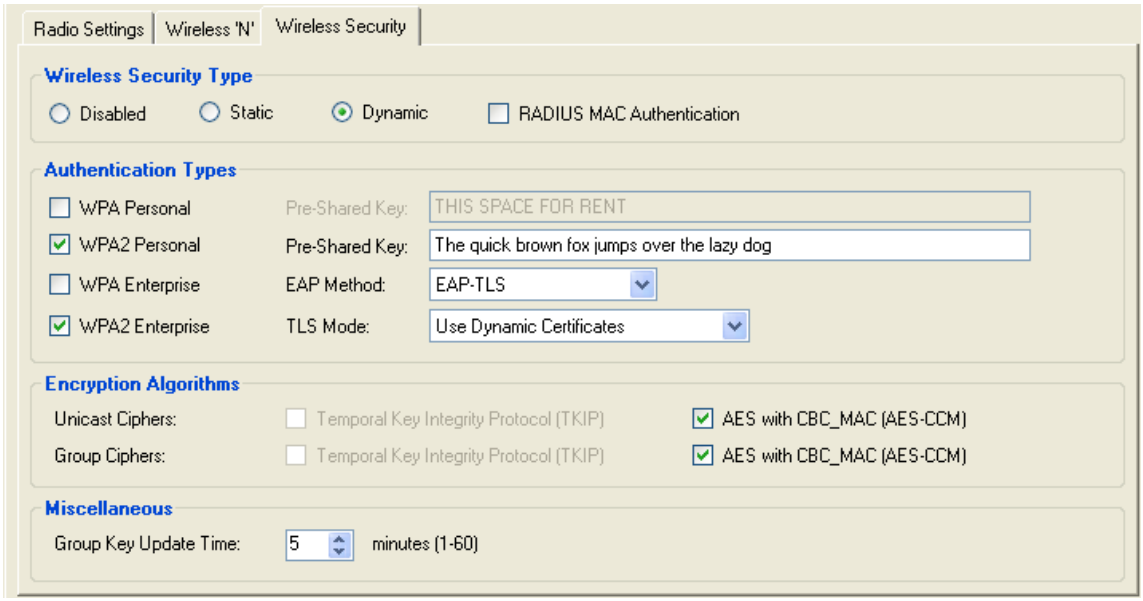
Dynamic Security Settings

The following screen shot shows the dynamic security options for a point-to-point radio:



The following tables describe the dynamic security options found in the *Wireless Security Settings* tab:

Authentication Types	
Field Name	**Description**
WPA Personal	Check this option to enable WPA personal authentication. You must also enter a pre-shared key used for the authentication process.
WPA2 Personal	Check this option to enable WPA2 personal authentication. You must also enter a pre-shared key used for the authentication process.
WPA Enterprise	Check this option to enable WPA enterprise authentication. This option does not require a pre-shared key.
WPA2 Enterprise	Check this option to enable WPA2 enterprise authentication. This option does not require a pre-shared key.

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Authentication Types	
Field Name	**Description**
EAP Method	Specify the authentication protocol to use. Two options are available: **Option** / **Description** Pass Through — Authentication requests are relayed to a RADIUS server. EAP-TLS — TLS certificates are used for authentication. This option is only used by the WPA Enterprise and WPA2 Enterprise authentication types. It is hidden if no enterprise option is selected.
TLS Mode	Specify how TLS certificates are to be used. Two options are available: **Option** / **Description** Use Dynamic Certificates — TLS certificates are negotiated dynamically using anonymous Diffie-Hellman MODP 2048 bit algorithm. Use Imported Certificates — A TLS certificate that has been imported into the radio is used. This option is only used when the **EAP Method** is set to EAP-TLS. It is hidden if the EAP-TLS option is not selected.

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Encryption Algorithms	
Field Name	**Description**
Unicast Ciphers	Check the ciphers that can be used to encrypt frames sent to individual radios. The following option is available. **Option** / **Description** AES-CCM: A more secure WPA encryption protocol, based on the reliable AES (Advanced Encryption Standard). Use this option is preferred if the there are no legacy WEP devices in the network. This TKIP option is not available in point-to-point devices.
Group Ciphers	Check the ciphers that can be used to encrypt frames broadcast to all radios. The following option is available. **Option** / **Description** AES-CCM: A more secure WPA encryption protocol, based on the reliable AES (Advanced Encryption Standard). Use this option is preferred if the there are no legacy WEP devices in the network. This TKIP option is not available in point-to-point devices.

Miscellaneous	
Field Name	**Description**
Group Key Update Time	The interval at which the dynamically generated keys are updated.

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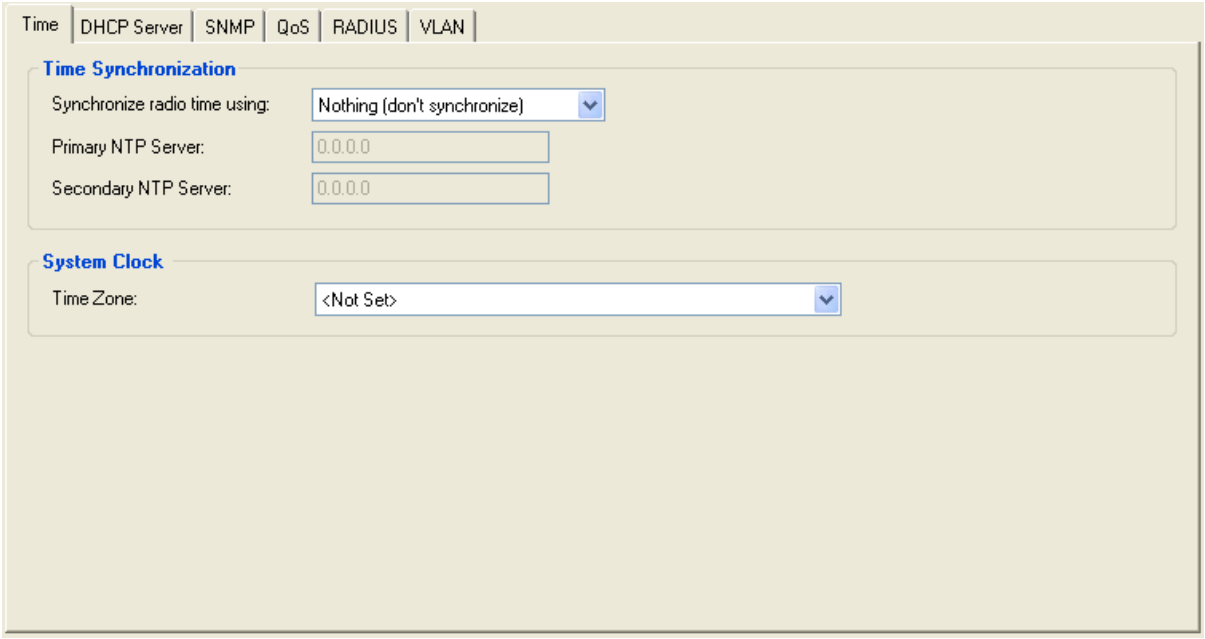
Network Tab

The following screen shot shows the network settings tab for a point-to-point radio:



Because a large number of configuration options are available, the network configuration tab is split up into a number of sub-tabs. The following topics describe the settings found in each sub-tab:

- Time Settings
- DHCP Server Settings
- SNMP Settings
- QoS (Quality of Service) Settings
- RADIUS Settings
- VLAN Settings

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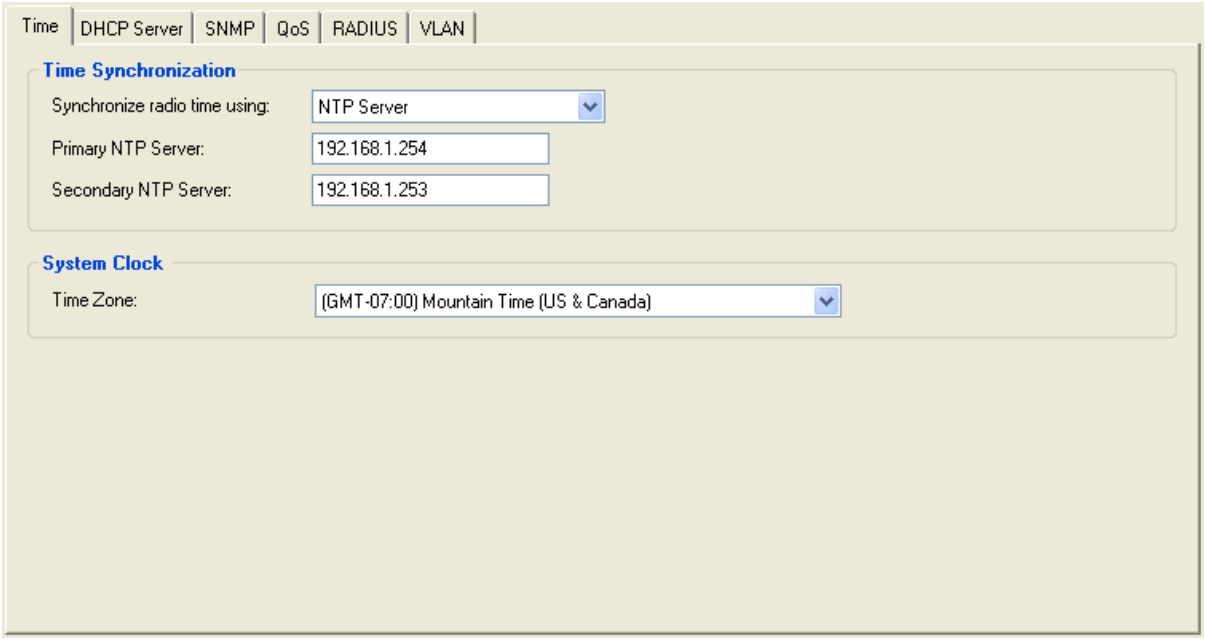
Time Settings

The following screen shot shows the NTP settings tab for a point-to-point radio:



The following table describes the time synchronization settings.

Time Synchronization	
Field Name	**Description**
Synchronize radio time using	Select one of the following options to set the system clock: **Option** / **Description** Nothing — The radio's time will only be synchronized when a configuration change is made by STRATOS. NTP Server — The radio will synchronize its internal clock to the specified NTP server time at regular intervals. GPS Receiver — The radio will synchronize its internal clock from the built-in GPS receiver. **Note:** This option is only available if the radio contains a GPS receiver.
Primary NTP Server	Specify the IP address of the NTP server used to synchronize the radio's internal clock. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:

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	 Note: This option is only enabled when the NTP Server option is selected.
Secondary NTP Server	If applicable, specify the IP address of the secondary NTP server. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If there is no secondary NTP server in your network, enter "0.0.0.0" in this field. **Note:** This option is only enabled when the NTP Server option is selected.

System Clock	
Field Name	**Description**
Time Zone	Select the time zone in which the radio is operating. Note that the time zone has no effect on the operation of the radio, and does not need to be set for normal operation. If the time zone is not set, the radio defaults to UTC time.

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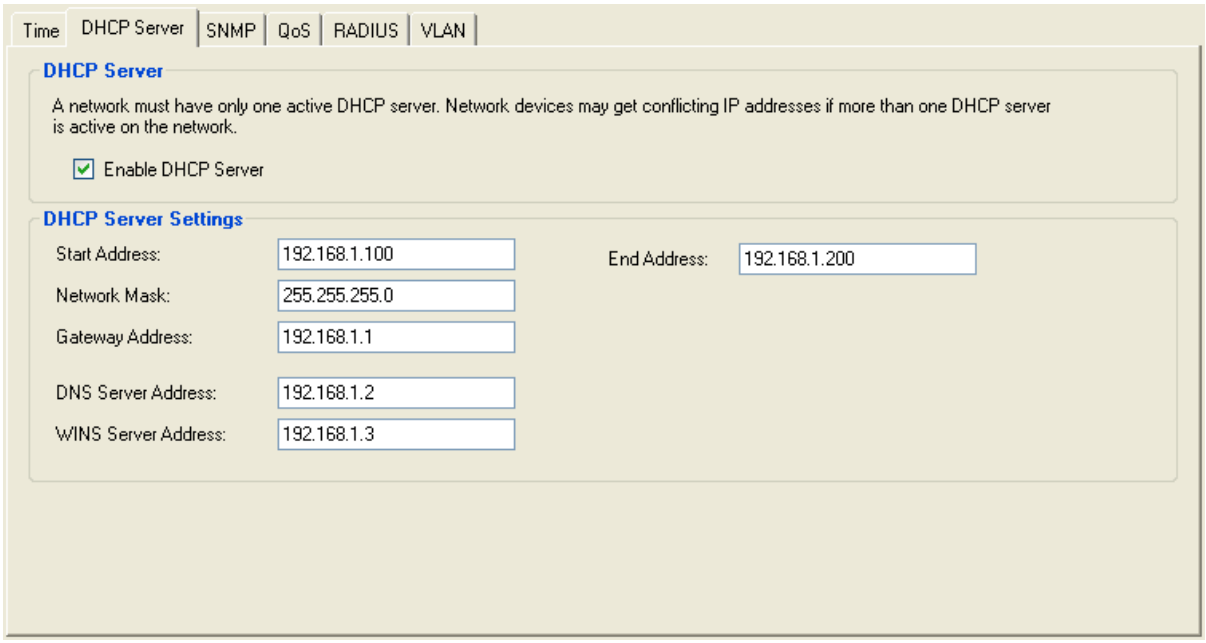
DHCP Server Settings

The following screen shot shows the DHCP server tab for a point-to-point radio:



The following table describes the DHCP server settings.

DHCP Server	
Field Name	**Description**
Enable DHCP Server	Check this option to enable the radio's DHCP server. When this option is enabled, the radio will assign IP addresses to any other radio, or any other other device, that is configured to obtain their IP addresses dynamically. **Important:** Severe network instability can occur if there is more than one DHCP server present in a network or network segment. Do not enable this option if a router or another radio is already acting as a DHCP server.

DHCP Server Settings	
Field Name	**Description**
DHCP Address Range	Specify the start and end range of the IP addresses that will be provided by the DHCP server, as shown in the following example:

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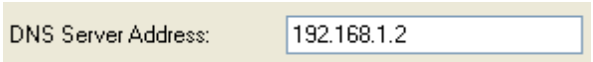
DHCP Server Settings	
Field Name	**Description**
	 In this example, IP addresses in the 192.168.1.100 - 192.168.1.200 range will be assigned to devices that use dynamic addressing. IP addresses outside this range would be manually assigned to devices that do not use dynamic addressing.
Network Mask	Enter the network mask that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:
Gateway Address	Enter the IP Address of the default gateway that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: The default gateway is the radio or router that provides access to devices outside of the local network.
DNS Server Address	Enter the IP Address of the DNS server that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:  If there is no DNS server available in your network, enter "0.0.0.0" in this field.
WINS Server Address	Enter the IP Address of the WINS server that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If there is no WINS server available in your network, enter "0.0.0.0" in this field.

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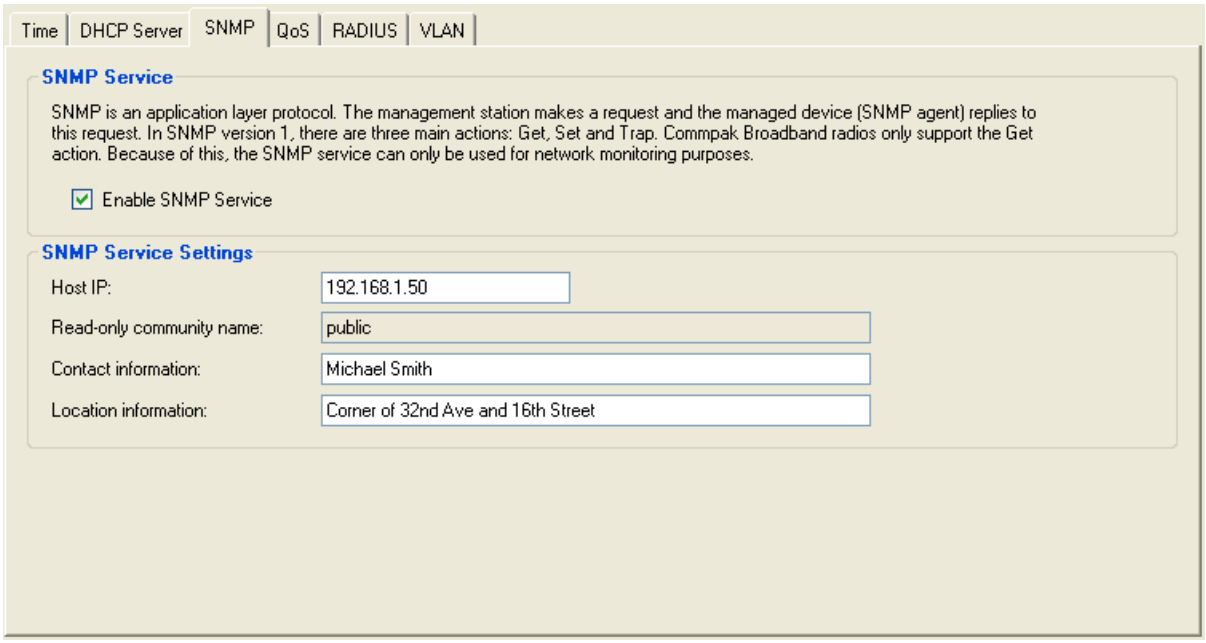
SNMP Settings

The following screen shot shows the SNMP tab for a point-to-point radio:


Time
DHCP Server
SNMP
QoS
RADIUS
VLAN
SNMP Service
SNMP is an application layer protocol. The management station makes a request and the managed device (SNMP agent) replies to this request. In SNMP version 1, there are three main actions: Get, Set and Trap. Commpak Broadband radios only support the Get action. Because of this, the SNMP service can only be used for network monitoring purposes.
Enable SNMP Service
SNMP Service Settings
Host IP:
192.168.1.50
Read-only community name:
public
Contact information:
Michael Smith
Location information:
Corner of 32nd Ave and 16th Street

The following tables describe the SNMP service settings.

SNMP Service	
Field Name	**Description**
Enable SNMP Service	Check this option enable the radio's SNMP (Simple Network Management Protocol) agent. When this option is enabled, diagnostic information can be obtained from the radio using any SNMP based network monitoring application.

SNMP Service Settings	
Field Name	**Description**
Host IP	Enter the IP address of the computer on which the network monitoring application is running, as shown in the following example: Host IP: 192.168.1.50 Setting this option will prevent any other computer from being able to access the radio's SNMP information. If you want to allow any computer that is on your network to access the radio's SNMP information, enter "0.0.0.0" in this field.

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Community Name	The community name used to access the radio's SNMP agent. This is set to 'public', and cannot be changed. Only read operations are permitted.
Contact Information	Enter the contact information of the individual responsible for the network, if applicable.
Location Information	Enter the location of the radio, if applicable.

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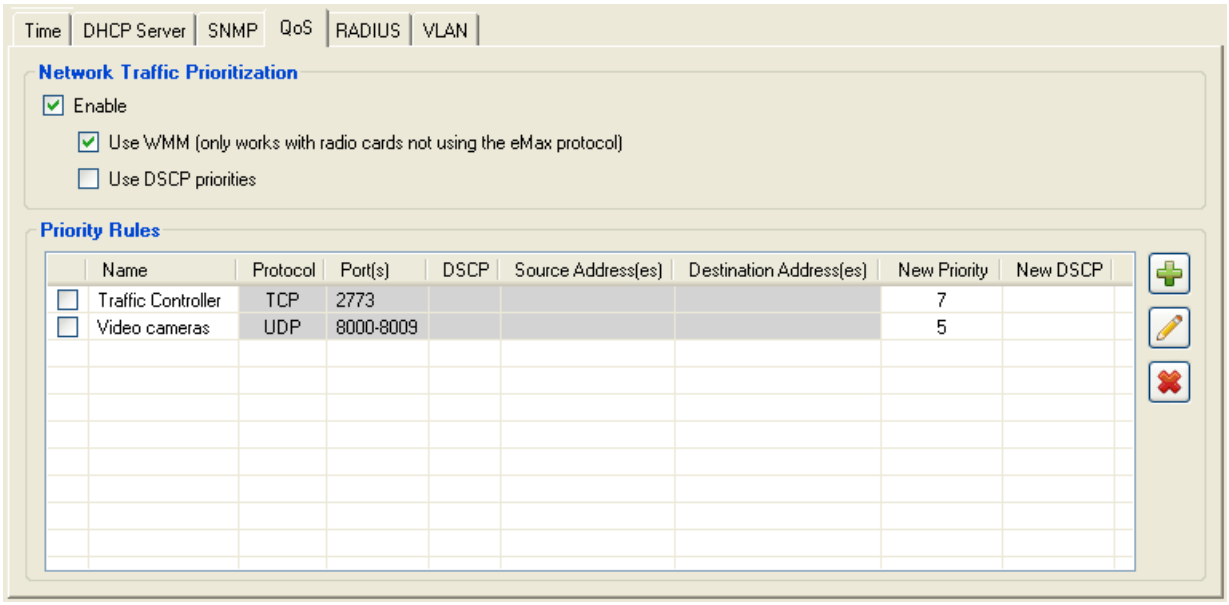
QoS Settings

The following screen shot shows the *QoS (Quality of Service)* settings tab for a point-to-point radio:



The Quality of Service settings allow you to prioritize the various types of network traffic so that important traffic is processed ahead of less important traffic.

Under normal conditions, all network data packets have an equal opportunity to be forwarded by the radio. This works well for some applications (such as file transfers or web browsing) but it is not adequate for traffic that is sensitive to network latency and throughput reductions (such as voice or video streaming). QoS allows you to address this issue by giving the time sensitive traffic a larger share of the network bandwidth.

Refer to Appendix D: Quality of Service for more detailed information on the prioritization mechanisms supported by the ENCOM radios.

The following tables describe the Quality of Service settings.

Network Traffic Prioritization	
Field Name	**Description**
Enable	Check this option to enable priority queue based QoS features. Priority rules are used to specify the priority of specific types of traffic. Lower priority traffic is dropped in preference to higher priority traffic when the radio becomes heavily loaded.
Use WMM	Check this option to set the priority of incoming packets to the incoming WMM priority (or to the incoming VLAN priority if VLANs are being used). WMM is used to prioritize certain type of traffic, such as VOIP (Voice Over IP) and video streams, that are sensitive to network latency and capacity

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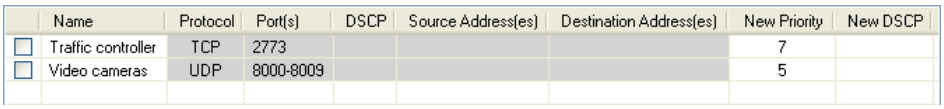
	issues. **Note:** The WMM/VLAN priorities must be set by the device that creates the network data packets or by the router or switch that provides access to the ENCOM radio network.
Use DSCP Priorities	Check this option to set the priority of incoming packets to the DSCP priority of the incoming data packets. **Note:** The DSCP priorities must be set by the device that creates the network data packets or by the router or switch that provides access to the ENCOM radio network.

Priority Rules

Field Name	Description
Priority Rule List	By default, ENCOM STRATOS will assign the highest priority to the radio management traffic. Other types of network traffic can be assigned to specific priority queues by creating custom priority rules. The **Priority Rules** list displays the custom priority rules that you have defined. When defining a priority rule, you specify the type of traffic that the rule is to act upon, and the priority to assign to the matching traffic. In the following example, two priority rules have been defined:



	Name	Protocol	Port(s)	DSCP	Source Address(es)	Destination Address(es)	New Priority	New DSCP
☐	Traffic controller	TCP	2773				7	
☐	Video cameras	UDP	8000-8009				5	

The shaded cells contain the criteria that must be matched in order for a network data packet to be affected by the rule. Matching data packets will be assigned the **New Priority** (and optionally the **New DSCP** value) defined in the rule.

The priority rule list is sorted by the **New Priority** column, in descending order.

The following table describes the information that is displayed in the **Priority Rules** list:

Column	Description
☐	To delete a rule, first check it, and then click on the **Remove** button at the right of the **Priority Rule** list to actually delete it.
Name	A short description that identifies the type of

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<table>
<tr><td></td><td>
<table>
<tr><td></td><td>network traffic associated with the rule.</td></tr>
<tr><td>Protocol</td><td>The protocol to match.</td></tr>
<tr><td>Port(s)</td><td>The IP port or ports to match. If blank, traffic on any port is affected by the rule.</td></tr>
<tr><td>Source Address(es)</td><td>The address or addresses that the data packets must originate from.</td></tr>
<tr><td>Destination Address(es)</td><td>The address or addresses that the data packets are being forwarded to.</td></tr>
<tr><td>DSCP</td><td>The DSCP value of the incoming packets to match. If blank, the DSCP priority is ignored by the rule.</td></tr>
<tr><td>New Priority</td><td>The priority to assign to the packets that match the specified criteria.</td></tr>
<tr><td>New DSCP</td><td>The DSCP value to assign to the packets that match the specified criteria.</td></tr>
</table>
</td></tr>
<tr><td>
(Add button)</td><td>Click the Add button to create a new priority rule. Enter the appropriate rule settings in the QoS Priority Rule form that is displayed.</td></tr>
<tr><td>
(Edit button)</td><td>Select a priority rule, and then click on the Edit button to modify the rule settings.
Alternatively, you can double-click on the rule you want to modify.</td></tr>
<tr><td>
(Remove button)</td><td>To delete a rule, first check it, and then click on the Remove button to actually delete it.</td></tr>
</table>

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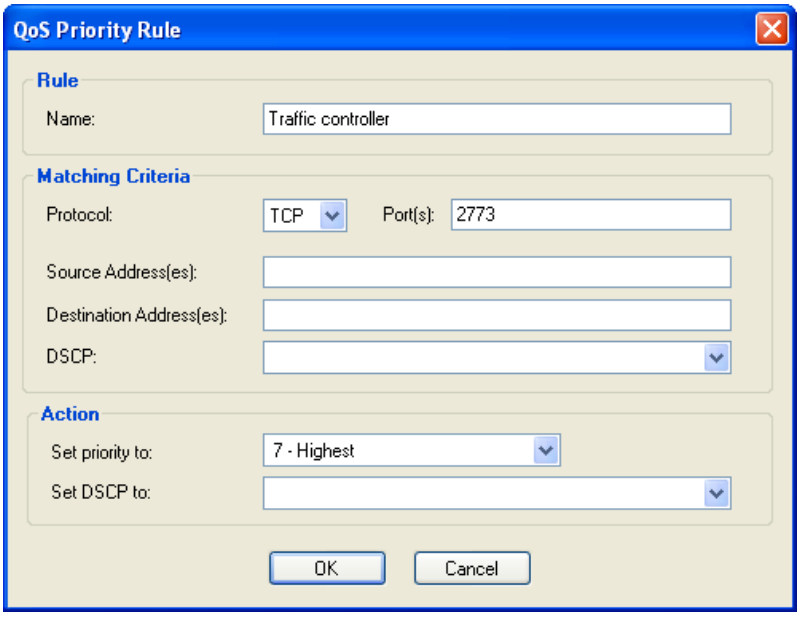
Specifying a QoS Priority Rule

The following screen shot shows the *QoS Priority Rule* form for a point-to-point radio:



The *QoS Priority Rule* form allows you to define a traffic priority rule.

The following tables describe the QoS rule settings.

Rule	
Field Name	**Description**
Name	Enter a short description that identifies the type of network traffic associated with the rule.

Matching Criteria	
Field Name	**Description**
Protocol	Specify the protocol that the rule will apply to. You can select one of the following values: **Protocol** / **Description** All / All network traffic will be matched. When you select this option, one or both of the **Source Address** and **Destination Address** fields must be set. Otherwise, all of the network traffic flowing through the radio would match the

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<table>
<tr><td></td><td>
<table>
<tr><td></td><td>rule.</td></tr>
<tr><td>UDP</td><td>The rule will only affect UDP traffic.</td></tr>
<tr><td>TCP</td><td>The rule will only affect TCP traffic.</td></tr>
</table>
</td></tr>
<tr><td>Ports</td><td>Optionally specify the port or ports associated with the network traffic that the rule will apply to. You can specify the ports using one of the following formats:
<table>
<tr><th>Format</th><th>Example</th></tr>
<tr><td>Single Port</td><td>1000</td></tr>
<tr><td>Multiple Ports</td><td>1000,2000</td></tr>
<tr><td>Port Range</td><td>1000-2000</td></tr>
<tr><td>Multiple Port Ranges</td><td>1000-2000,3000-4000</td></tr>
</table>
If this value is not specified, the rule will apply to all traffic of the selected protocol type.</td></tr>
<tr><td>Source Address(es)</td><td>Optionally specify the address or addresses that the data packets must originate from. You can specify the addresses using one of the following formats:
<table>
<tr><th>Format</th><th>Example</th></tr>
<tr><td>Single IPV4 Address</td><td>192.168.1.100</td></tr>
<tr><td>IPV4 Address Range</td><td>192.168.1.100-192.168.1.200</td></tr>
<tr><td>IPV4 CIDR Subnet</td><td>192/168.1.1/24</td></tr>
</table>
If this value is not specified, the rule will apply to all destination addresses.</td></tr>
<tr><td>Destination Address(es)</td><td>Optionally specify the address or addresses that the data packets are being forwarded to. You can specify the addresses using one of the following formats:
<table>
<tr><th>Format</th><th>Example</th></tr>
<tr><td>Single IPV4 Address</td><td>192.168.1.100</td></tr>
</table></td></tr>
</table>

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	<table><tr><td>IPV4 Address Range</td><td>192.168.1.100-192.168.1.200</td></tr><tr><td>IPV4 CIDR Subnet</td><td>192/168.1.1/24</td></tr></table> If this value is not specified, the rule will apply to all destination addresses.
DSCP	Optionally specify the DSCP (Differentiated Services Code Point) value in the IP header that the rule will apply to. You can select a predefined DSCP value from the drop-down list, or enter a number between 0 and 63. If this value is not specified, the rule will apply to all DSCP values.

Action	
Field Name	**Description**
Set priority to	The priority to assign to the packets that match the specified criteria. The higher the priority value, the higher the priority assigned to the associated network traffic.
Set DSCP to	Optionally specify the DSCP (Differentiated Services Code Point) value to assign to the packets that match the specified criteria. You can select a predefined DSCP value from the drop-down list, or enter a number between 0 and 63. If this value is not specified, no change will be made to the packet's DSCP value.

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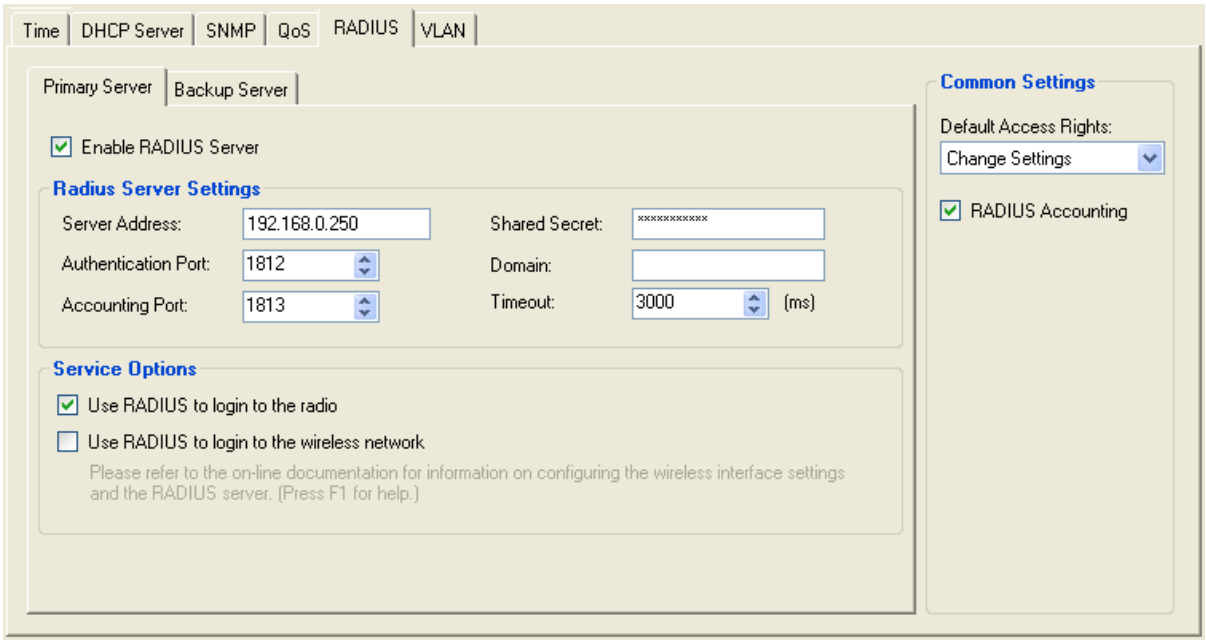
RADIUS Settings

The following screen shot shows the *RADIUS* settings tab for a point-to-point radio:



RADIUS is used to centralize the authentication of users that attempt to login to the radio and/or to the network. Refer to **ENCOM STRATOS RADIUS Configuration Guide**, available separately, for more information on setting up and using a RADIUS server with your radio network.

The following tables describe the settings found in each group in the RADIUS settings tab.

Primary and Secondary Server	
Field Name	**Description**
Enable RADIUS Server	Check this setting to enable the associated RADIUS server (Primary or Backup). If the radio cannot connect to the primary RADIUS server, it will attempt to connect to the backup RADIUS server.
Server Address	Enter the IP address of the RADIUS server.
Authentication Port	Enter the IP port on which RADIUS authentication requests are accepted. The default is 1812.
Accounting Port	Enter the IP port on which RADIUS accounting updates are accepted. The default is 1813.
Shared Secret	Enter a string that is used to obfuscate the user password that is sent to the RADIUS server for authentication. This value must match the Shared Secret that is configured in the RADIUS server.

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Domain	Enter the Microsoft Windows domain of the user. Only use if the RADIUS server requires domain validation.
Timeout	Enter the maximum amount of time (in milliseconds) to wait for a response from the RADIUS server before resending an authentication request. The default is 300 ms. You may need to increase this if your RADIUS server is slow to respond to authentication requests.
Use RADIUS to login to the radio	Check this option to use RADIUS to authenticate radio login requests. When this option is enabled, the radio will check with the RADIUS server if it does not find the specified user in its local user database.
User RADIUS to login to the wireless network	Check this option to use RADIUS to authenticate client devices that wish to attach to your network (e.g. for access to the network operations center or to your corporate LAN). If you select this option, you will need to check the RADIUS MAC Authentication setting for each of the radio cards that clients will use to connect to the network.

Common Settings

Field Name	Description
Default Access Rights	Select the access rights to assign to the user if the RADIUS server is not configured to respond to an authentication request with the user's group name. The following table describes the options that are available for this setting: **Option** / **Description** View Settings — The user will be able to inspect the radio's configuration settings, but will not be able to make any changes. Change Settings — The user will be able to inspect and change the radio's configuration settings. This setting is ignored if the RADIUS server responds to an authentication request with the user's group name.
RADIUS Accounting	Check this option to send RADIUS accounting packets to the RADIUS server. This information is normally used for user billing, and is not usually needed for typical ENCOM radio networks.

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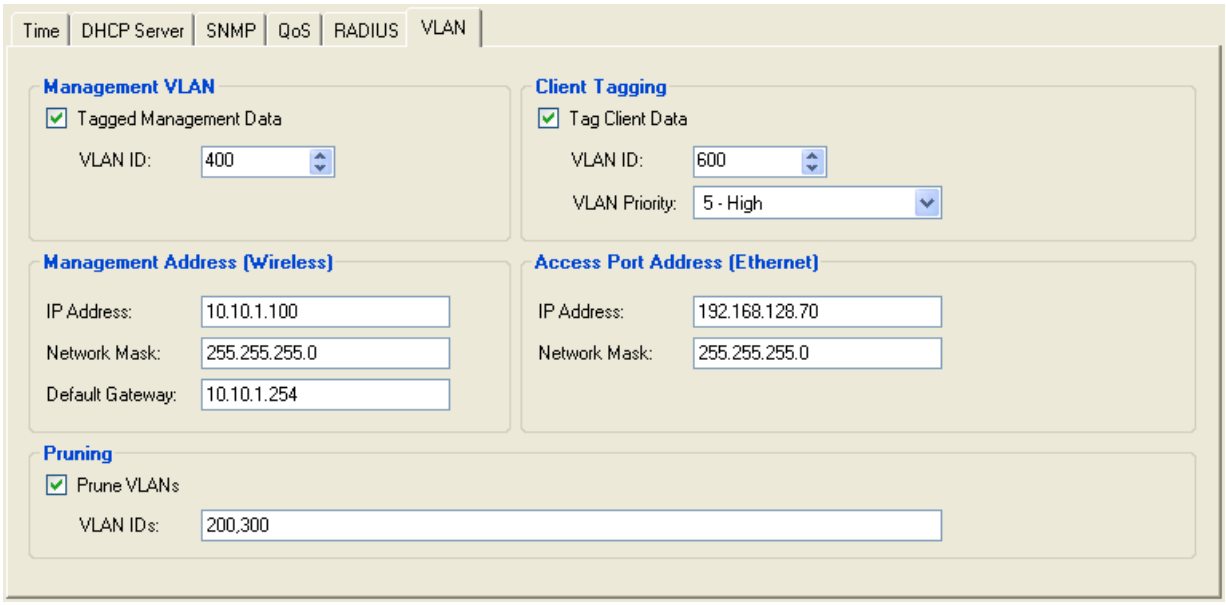
VLAN Settings

The following screen shot shows the *VLAN* settings tab for a point-to-point radio:



VLANs (Virtual LANs) are used to improve the performance, and possibly the security, of a radio network. Refer to Appendix E: VLAN Support for more information on implementing a VLAN-based network.

The following tables describe the settings found in each group in the VLAN settings tab.

Management VLAN	
Field Name	**Description**
Tagged Management Data	By default, the radio can be managed by connections over the native (non-tagged) VLAN. To be able to manage the radio using a specific VLAN, check this option, and enter the appropriate management VLAN ID in the **VLAN ID** field.
VLAN ID	Enter the ID of the management VLAN (a number in the range 1-4095 is required).

Client Tagging	
Field Name	**Description**
Tag Client Data	Normally, all of the radio's interfaces (wireless and Ethernet) act as VLAN trunks (i.e. they carry the network traffic for all VLANs). If a normal, non-VLAN aware device is plugged into the radio's Ethernet port, its network traffic will not be tagged, and it will not be able to communicate with

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	devices that are part of a VLAN. Check this option to set up the radio's Ethernet port as an access port for a specific VLAN. This gives devices connected to the Ethernet port access to the other devices in the specified VLAN.
VLAN ID	Enter the ID of the client VLAN to (a number in the range 1-4095 is required).
VLAN Priority	The priority to assign to the packets originating from the Ethernet port. The higher the priority value, the higher the priority assigned to the associated network traffic. **Note:** In order to prioritize the wireless network traffic using the VLAN priority, the appropriate QoS options need to be configured. See the Using WMM to Support VLAN Priority Traffic topic for more information.

Management Address (Wireless)

Field Name	Description
IP Address	Enter the IP address used to access the radio via its wireless interfaces. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tagged Management Data** option is checked, this IP address should be compatible with the management VLAN's network address range.
Network Mask	Enter the network mask of the network used to access the radio via its wireless interfaces. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tagged Management Data** option is checked, this mask should be compatible with the management VLAN's network mask.

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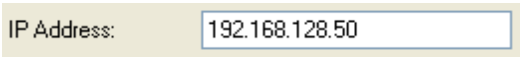
Default Gateway	Enter the IP address of the radio, router or switch that allows this radio to connect with devices that are outside of their local LAN or VLAN. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tagged Management Data** option is checked, this IP address would normally be the IP address of the network's gateway radio, or the IP address of the router or switch used to access external networks.

Access Port Address (Ethernet)

Field Name	Description
IP Address	Enter the IP address used to access the radio via its Ethernet interface. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:  If the **Tag Client Data** option is checked, this IP address should be compatible with the client VLAN's network address range.
Network Mask	Enter the network mask of the network used to access the radio via its Ethernet interface. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tag Client Data** option is checked, this mask should be compatible with the client VLAN's network mask.

Pruning

Field Name	Description
Prune VLANs	Check this option to prevent the radio for forwarding network traffic associated with specific VLAN IDs.
VLAN IDs	Enter one or more VLAN IDs to prune. Separate individual IDs with commas. Any incoming network traffic that matches the specified VLAN IDs will be dropped by the radio.

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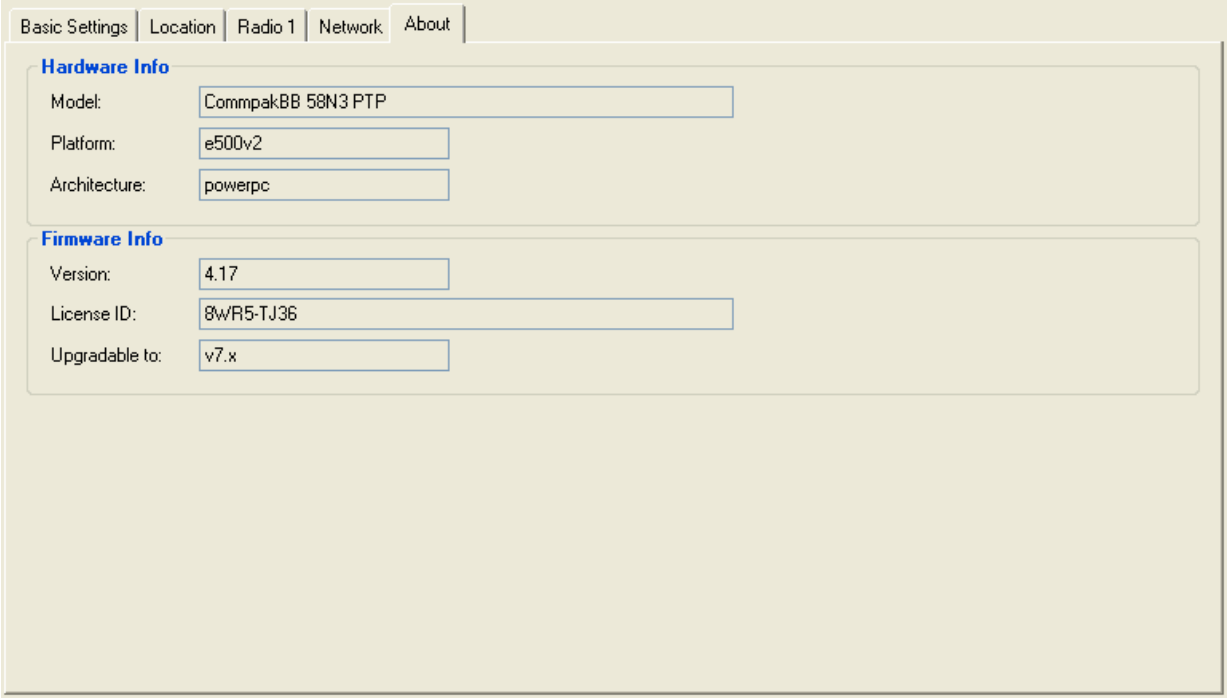
About Tab

The following screen shot shows the About tab for a point-to-point radio:



This tab displays information regarding the radio's hardware and firmware. It does not contain any user editable fields.

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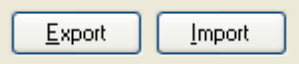
Export and Import Buttons

The **Export** and **Import** buttons in the lower left-hand corner of the radio configuration form allow you to save the radio's configuration settings to a file, and to update the radio's configuration settings from a previously saved configuration file.



Refer to the following topics for more information on these functions:

- Exporting the Radio Configuration
- Importing the Radio Configuration

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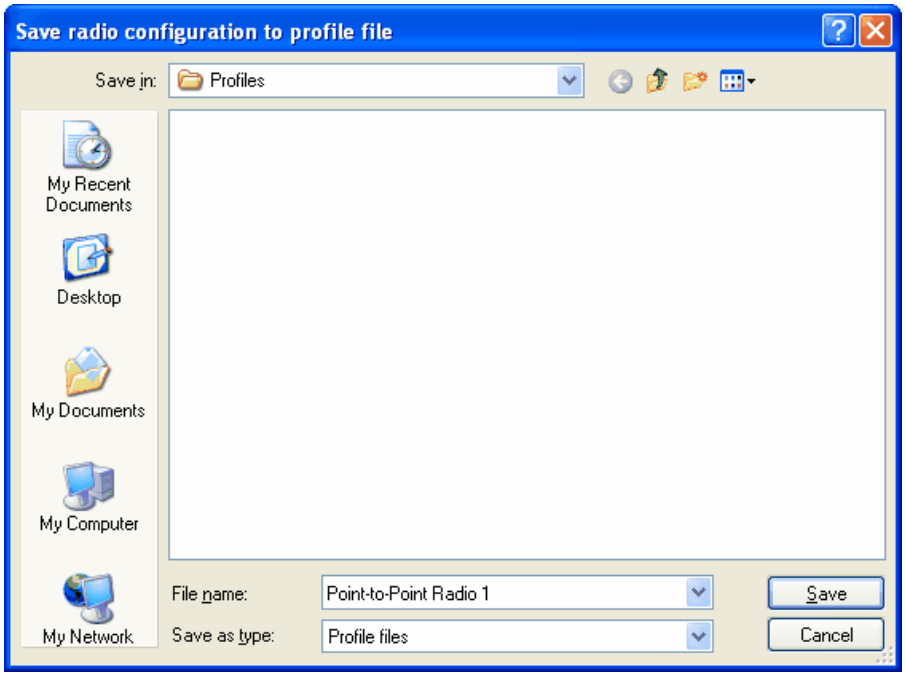
Exporting the Radio Configuration

The **Export** function is used to save the radio's current settings to a configuration profile file. This allows you to:

- Make a backup copy of the radio's configuration.
- Save the radio's configuration to a profile or template file for use in configuring other radios.

To export a radio's configuration:

1. From the radio's configuration form, click on the **Export** button. The *Save configuration profile file* form is displayed:



2. Specify the name of the file you want to save the radio's configuration settings to, and then press the **Save** button to save the settings.

   By default, STRATOS saves configuration profile files in the *'My Documents\Encom Wireless\Profiles'* folder.

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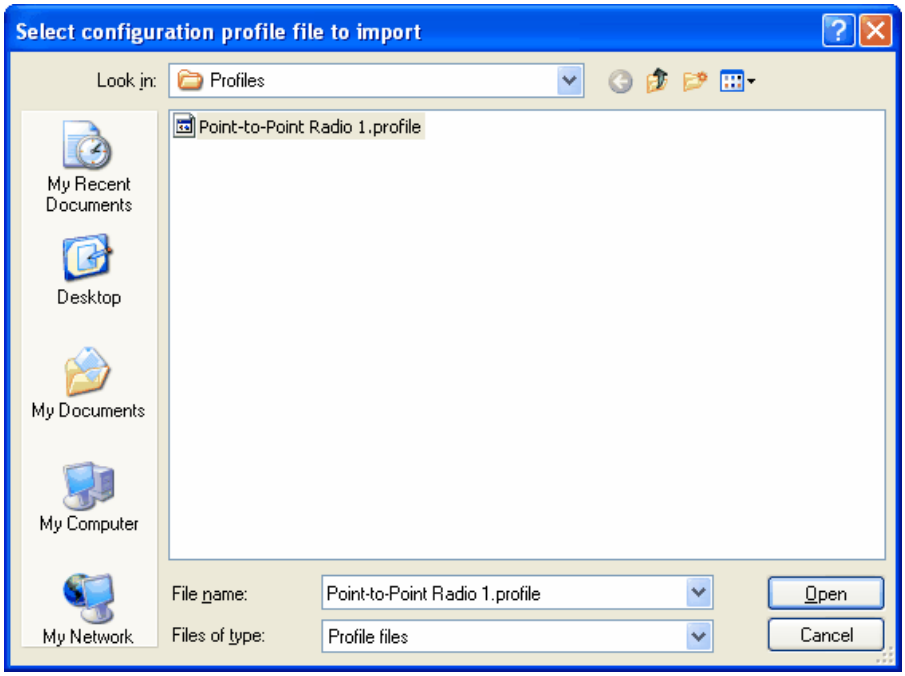
Importing the Radio Configuration

The **Import** function allows you to update the radio's settings from a previously saved configuration profile file. This function allows you to:

- Restore the radio's configuration from a backup file. This can be useful when you have to replace a radio in the field.
- Apply the settings from one radio to another. This can be used to provision new radios quickly, and ensure that they are compatible with other radios in the network.

To configure a radio using a saved configuration file:

1. From the radio's configuration form, click on the **Import** button. The *Select configuration profile file* form is displayed:



2. Select the configuration profile you want to import, and press the **Open** button.

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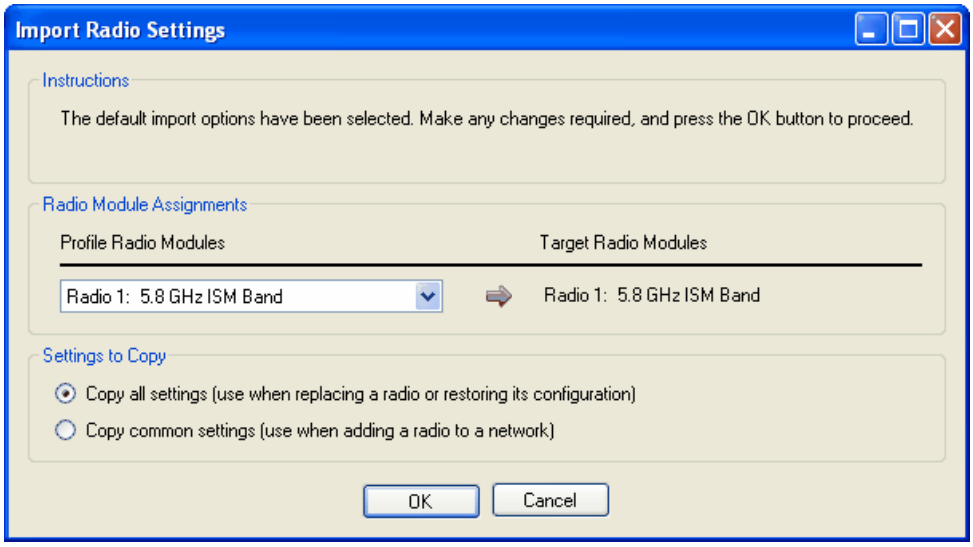
3. The *Import Radio Settings* form will be displayed:


Import Radio Settings
Instructions
The default import options have been selected. Make any changes required, and press the OK button to proceed.
Radio Module Assignments
Profile Radio Modules
Target Radio Modules
Radio 1: 5.8 GHz ISM Band
Radio 1: 5.8 GHz ISM Band
Settings to Copy
Copy all settings (use when replacing a radio or restoring its configuration)
Copy common settings (use when adding a radio to a network)
OK
Cancel

4. The *Radio Module Assignments* group allows you to specify how the radio module settings are applied:

The **Target Radio Modules** column lists the wireless radio modules that are present on the radio.

The **Profile Radio Modules** column shows the options that are available for each wireless interface that is present on the radio. STRATOS will find the best match between the profile and target radio modules, and will assign these by default. You can change the default assignments by selecting the appropriate items from the list boxes.

In the example shown above, STRATOS applied the matching radio modules from the profile to the target radio modules. If you didn't want to disturb the configuration of the wireless radio module, then you would select the **Don't Copy** option from the list box, as shown below:

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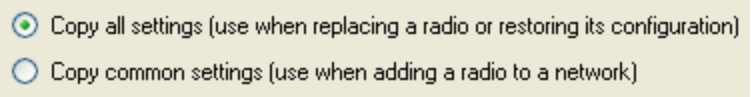
5. The **Settings to Copy** options allow you to specify what settings to import from the configuration profile:


Copy all settings (use when replacing a radio or restoring its configuration)
Copy common settings (use when adding a radio to a network)

These are described further in the following table:

Option	Description
Copy all settings	Use this option when you need to configure a radio so that it matches the configuration profile exactly. This option is most often used when configuring a replacement radio, or you want to restore the radio's configuration from a backup.
Copy common settings	Use this option to exclude those settings that are unique to the radio. This option is most often used when you are adding a new radio to a network, and you want to configure it to match the other radios in the network. The following items will **not** get copied over from the profile file to the radio: • Radio name • Radio Description • Radio latitude, longitude and street address • Radio static IP address

6. Press the **OK** button to apply the profile settings to the radio.
7. Make any changes to the imported settings in the radio configuration form.
8. Press the **Save** button on the radio configuration form to save the settings to the radio.

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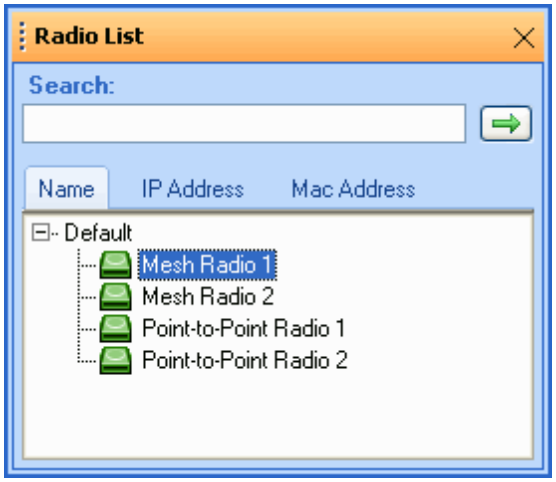
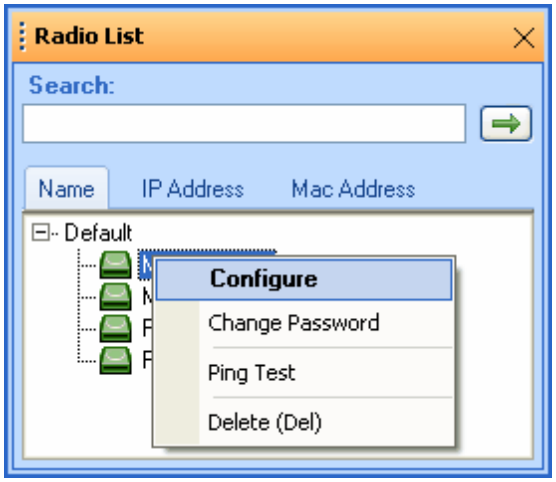
Configuring Mesh Radios

To configure a mesh radio:

1. Locate the radio you would like to configure in the Radio List. Ensure that it is currently on-line (a green icon is displayed at the left of an on-line radio):



2. Click the right mouse button on the radio name, and select **Configure** from the pop-up menu that is displayed:



Alternatively, you can either double-click the left mouse button on the radio name, or click the left mouse button on the radio name, and select **Radio -> Configure** from the main menu.

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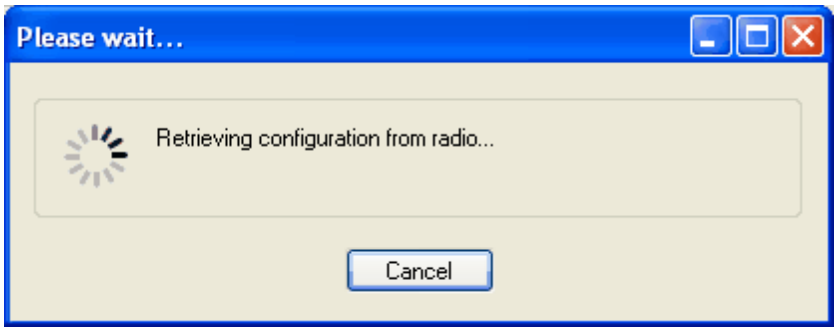
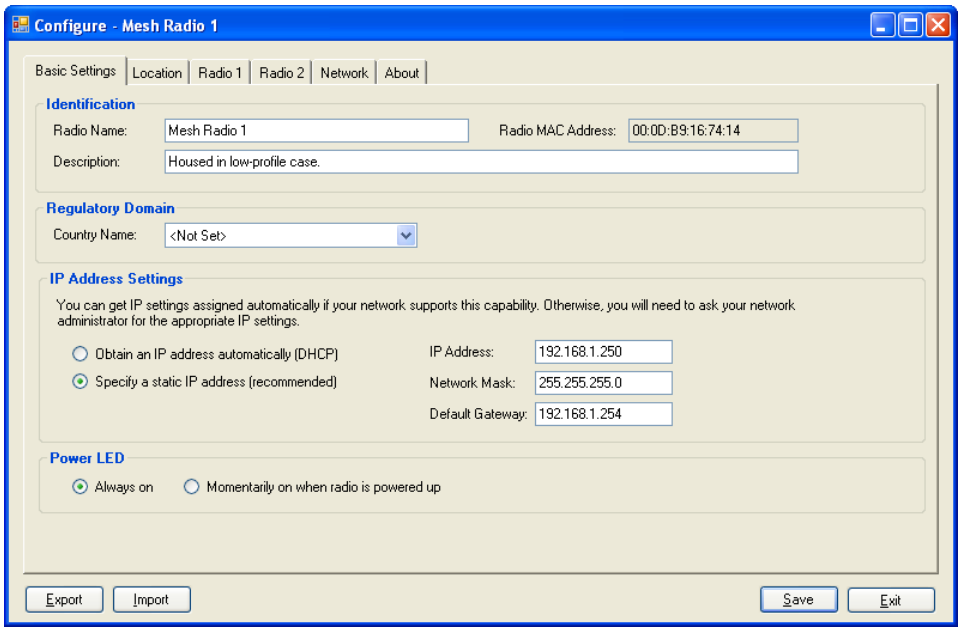
3. STRATOS will download the radio's current configuration. This process will normally take a few seconds to complete. During this time, a wait form is displayed:



4. When the radio's configuration has been obtained, the radio configuration form is displayed:



The configuration settings are logically grouped using a tabbed interface. The following topics describe the settings found in each tab:

- Basic Settings tab
- Location tab
- Radio tab
- Network tab
- About tab

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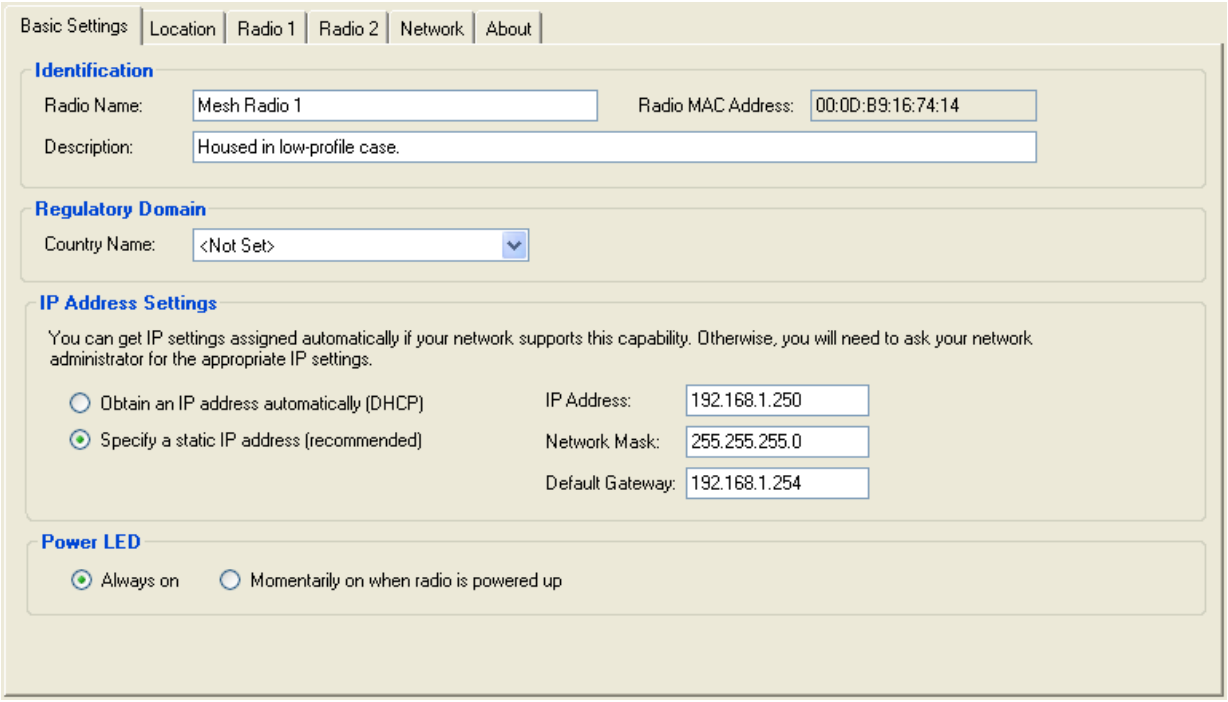
Basic Settings Tab

The following screen shot shows the basic configuration settings tab for a mesh radio:



The following tables describe the settings found in each group in the basic settings tab.

Identification	
Field Name	**Description**
Radio Name	Enter a name used to identify the radio (up to a maximum of 64 characters). The name you enter will be displayed in the radio list, and in all other places where a reference to the radio is made.
Radio MAC Address	Displays the MAC address assigned to the radio. (This is essentially the MAC address of the radio's first Ethernet adapter.)

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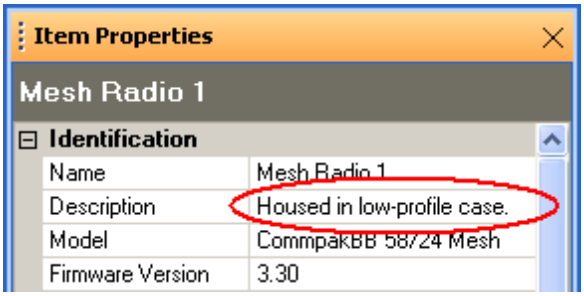
Identification	
Field Name	**Description**
Description	Enter an optional description for the radio. This field allows you to keep track of ad-hoc information associated with the radio, without adding clutter to the radio name. The radio description is displayed in the radio properties panel: 

Regulatory Domain	
Field Name	**Description**
Country Name	Select the country in which the radio is operating. Certain countries have limitations on the radio power output, allowed frequency ranges and frequency bands. Failure to select the appropriate country can result in a radio that is operating outside of the legally allowed ranges. If the radio is operating in the United States or Canada, you can leave this setting to **<Not Set>**.

IP Address Settings	
Field Name	**Description**
Obtain an IP address automatically	Select this option if a DHCP server is available on your radio network, and you want the DHCP server to assign an IP address to the radio.
Specify a static IP address	Select this option to manually assign the radio's IP address. ENCOM recommends this option because it provides for a more secure network (especially if you have not enabled wireless security). **Note:** It is important that each radio in the network is assigned a different IP address. Network performance can suffer greatly if two or more radios are assigned the same IP address.

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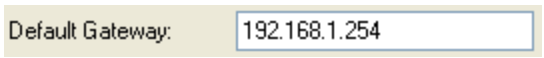
IP Address Settings	
Field Name	**Description**
IP Address	Enter the IP address of the radio. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:
Network Mask	Enter the network mask. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:
Default Gateway	Enter the IP address of the radio or router that allows the radio to connect with devices that are outside of their local LAN or VLAN. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:  Note that the default gateway's IP address must be in the same subnet as the radio's IP address.

Power LED	
Field Name	**Description**
Always On	The external power LED is on as long as the radio is powered. **Note:** This option is visible only if the radio supports an external power indicator LED.
Momentarily on when radio is powered up	The external power LED is on for 1 minute after the radio is powered, and is subsequently turned off. **Note:** This option is visible only if the radio supports an external power indicator LED.

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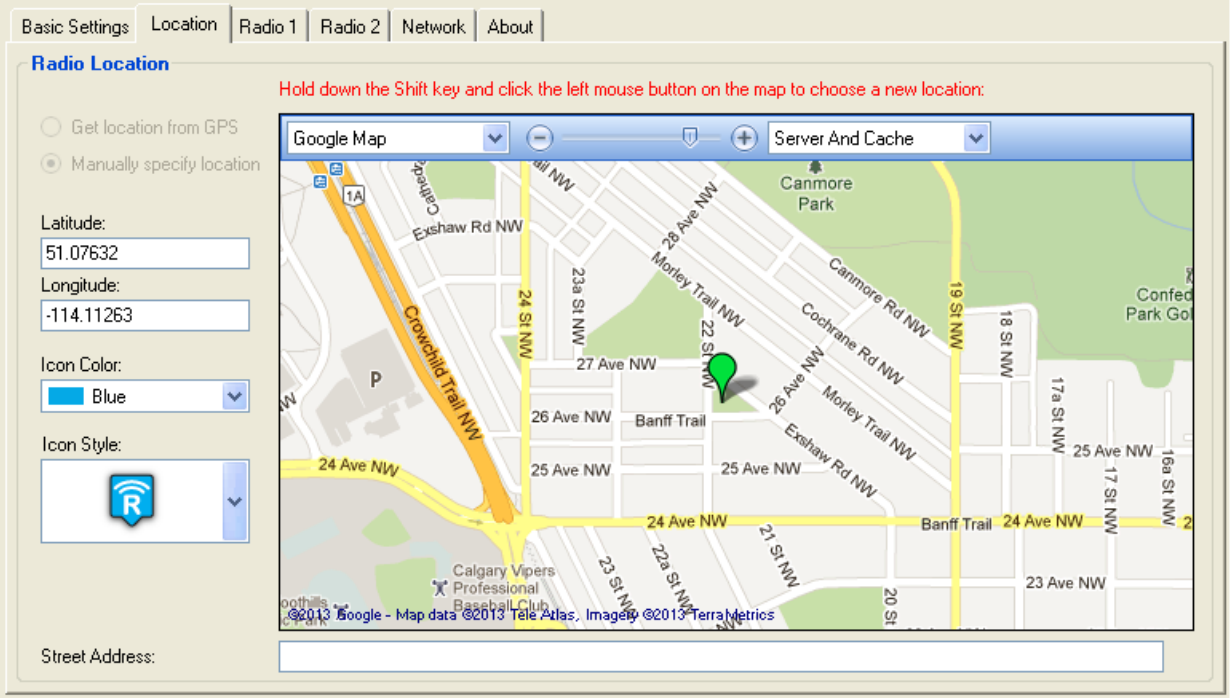
Location Tab

The following screen shot shows the location settings tab for a mesh radio:



The following table describes the settings found in the location tab.

Field Name	Description
Get location from GPS	Select this option if you want the radio to get its location from the built-in GPS receiver. This option is not available if the radio does not contain a GPS receiver.
Manually specify location	Select this option if you want to manually specify the location of the radio.
Latitude	Enter the latitude at which the radio is located, in decimal degrees. This value is positive in the northern hemisphere and negative in the southern hemisphere. Alternatively, hold down the Shift key and click the left mouse button on the map to set the radio's position. This process will automatically update the **Latitude** field.
Longitude	Enter the longitude at which the radio is located, in decimal degrees. This value is positive in the eastern hemisphere and negative in the western hemisphere. Alternatively, hold down the Shift key and click the left mouse button on

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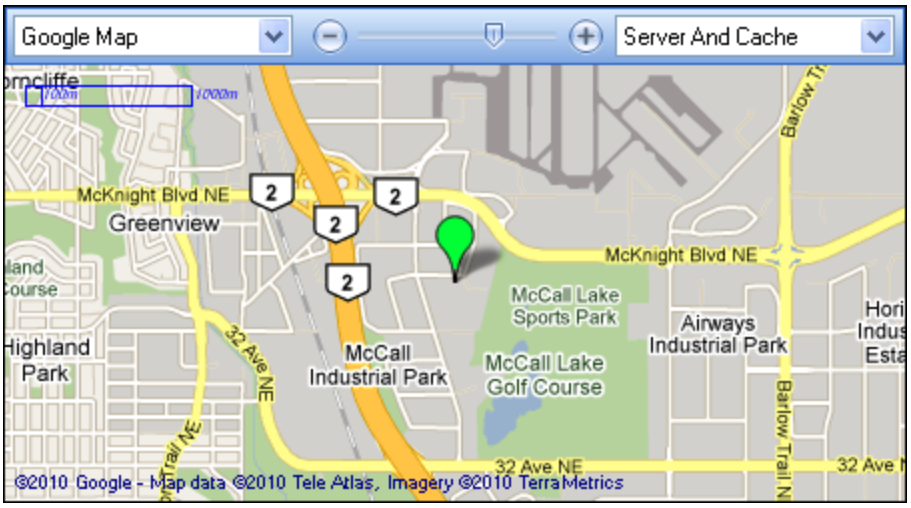
<table>
<tr><td></td><td>the map to set the radio's position. This process will automatically update the Longitude field.</td></tr>
<tr><td>Icon Color</td><td>Select the color of the radio icon. You can use the icon color to visually group radios by radio type, geographical location, VLAN association, etc.</td></tr>
<tr><td>Icon Style</td><td>Select the style of the radio icon. Four icon styles are currently available:
<table>
<tr><th>Icon</th><th>Radio Type</th></tr>
<tr><td> </td><td>Generic radio</td></tr>
<tr><td> </td><td>Master radio</td></tr>
<tr><td> </td><td>Remote radio</td></tr>
<tr><td> </td><td>Repeater radio</td></tr>
<tr><td> </td><td>Dual radio</td></tr>
</table></td></tr>
<tr><td>Embedded map</td><td>The embedded map allows you to see the current location of the radio. A green marker shows the location assigned to the radio.

</td></tr>
</table>

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	To set a new location: • Press and hold down the Shift key on your computer's keyboard. • Click the left mouse button at the location you want to assign to the radio. • The green marker will move to the selected position. **Note:** Refer to the Map Panel topic for more information on the embedded map features.
Street Address	Enter the street address of the radio, if applicable. This information is optional.

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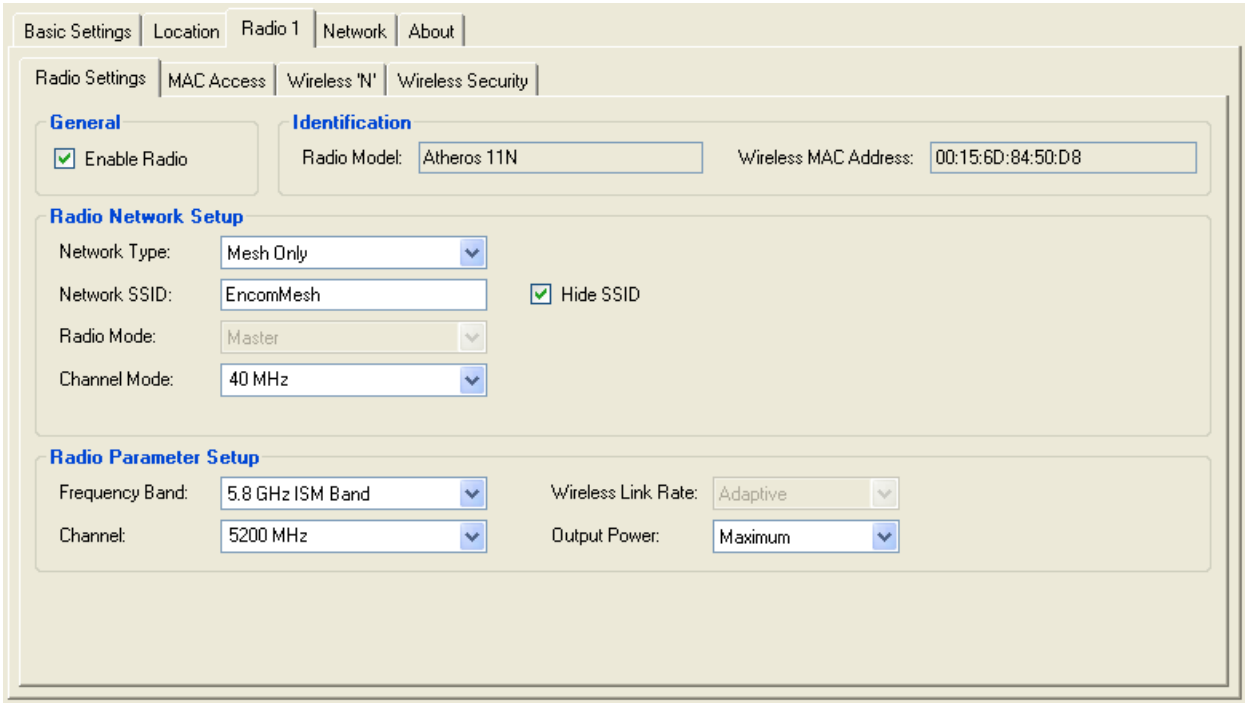
Radio Tab

ENCOM mesh radios contain at least one, and as many as four, wireless radio modules. Each wireless radio module is configured in its own tab. The first radio module is configured in the **Radio 1** tab, the second radio is configured in the **Radio 2** tab, and so on.

The following screen shot shows the radio settings tab for a mesh radio:



Because the wireless radio settings are somewhat involved, the radio configuration tab is split up into three sub-tabs. The following topics describe the settings found in each sub-tab:

- Radio Settings sub-tab
- MAC Access sub-tab
- Wireless 'N' sub-tab
- Wireless Security Settings

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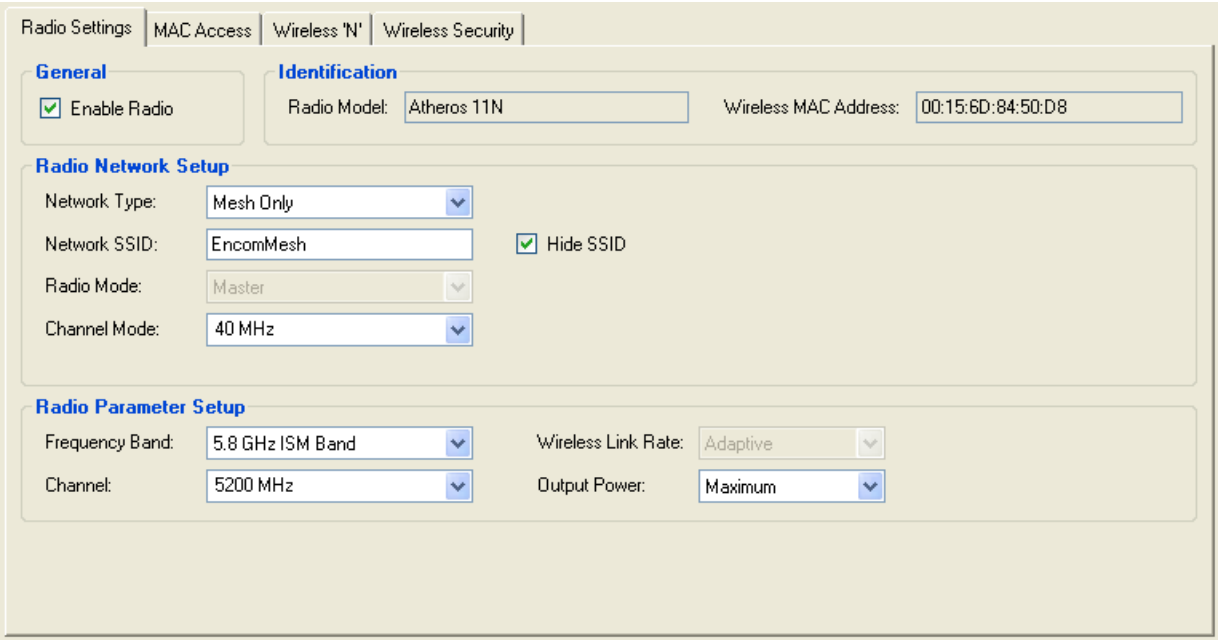
Radio Settings

The following screen shot shows the wireless radio settings tab for a mesh radio:



The following tables describe the settings found in each group in the wireless radio settings tab.

General	
Field Name	**Description**
Enable Radio	Uncheck this option to disable the wireless radio card. A disabled radio card will not be able to form wireless links with other radios. If you uncheck this option, all of the other options in the *Radio Settings* tab will be disabled.

Identification	
Field Name	**Description**
Radio Model	Displays the model number of the wireless radio card. This information is useful when troubleshooting issues with the radio.
Wireless MAC Address	Displays the MAC address assigned to the wireless radio card. For mesh radios, the MAC address of the wireless radio cards are different than the MAC address of the radio's Ethernet interface.

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<table>
<tr><th colspan="2">Radio Network Setup</th></tr>
<tr><th>Field Name</th><th>Description</th></tr>
<tr><td>Network Type</td><td>Select the role of the mesh radio. One of the following options can be specified:
<table>
<tr><th>Role</th><th>Description</th></tr>
<tr><td>Mesh Only</td><td>The wireless radio can only connect to other mesh radios (no clients allowed). This option provides the most secure and highest performance link.</td></tr>
<tr><td>Mesh and Clients</td><td>The wireless radio can connect to other mesh radios and can accept connections from client devices.
This option can be used to allow field technicians access to the mesh or to allow wireless devices and sensors to be accessed from the mesh network.</td></tr>
<tr><td>Clients Only</td><td>The wireless radio can only accept connections from client devices. It cannot connect to other mesh radios.
This option can be used for stand-alone applications, such as wireless hot-spots.</td></tr>
</table></td></tr>
<tr><td>Network SSID</td><td>Enter a name used to identify the network in which the wireless radio will take part. The Network SSID is case sensitive, and may contain spaces.
Note: You should change the default SSID assigned at the factory to a unique SSID for your network. You can minimize interference between adjacent networks by assigning a unique SSID for each network.
Important: All radios that participate in the same network must be assigned the same Network SSID.</td></tr>
<tr><td>Hide SSID</td><td>Check this option to prevent the Network SSID from being broadcast by the wireless radio. This prevents external devices from being able to discover the network's SSID (and potentially connect to it).</td></tr>
<tr><td>Radio Mode</td><td>Mesh radios are always considered to be master radios. This setting is for your information only, and cannot be changed.</td></tr>
</table>

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Radio Network Setup	
Field Name	**Description**
Channel Mode	This option allows you to set the width of the frequency channel you are using. Selecting a smaller frequency for the Channel Mode increases the distance over which you can establish a wireless link, at the cost of reduced bandwidth. For most applications 40 MHz is acceptable.

Radio Parameter Setup	
Field Name	**Description**
Frequency Band	Displays the nominal frequency at which the radio operates. This option can be changed if the radio card supports more than one band.
Channel	Select the radio's operating frequency. **Note:** All of the radios in the network must be set to the same frequency in order for them to communicate with each other.
Wireless Link Rate	Mesh radios use an adaptive algorithm to choose the best bit rate for the current link conditions. This setting is for your information only, and cannot be changed.
Output Power	Select the wireless radio's output power. Unless constrained by the Regulatory Domain that the radio is operating in, you should use the *Maximum* power setting when the radio is deployed in the field. If the radio is being provisioned or tested in a bench environment, you should use the *Low* power setting.

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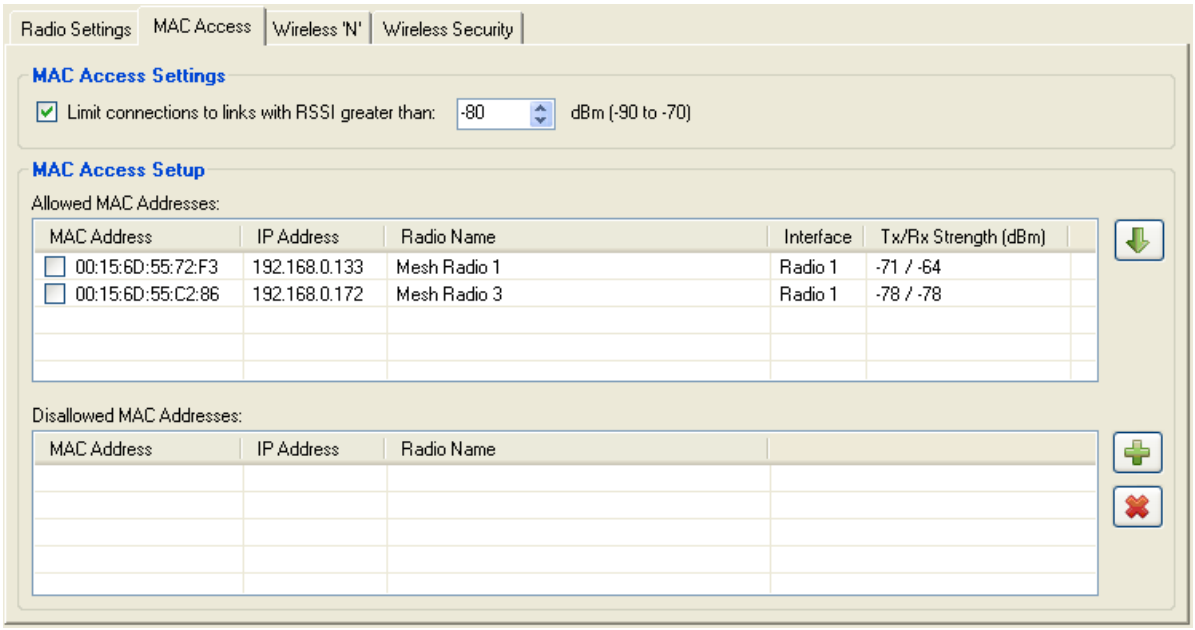
MAC Access Settings

The following screen shot shows the MAC Access tab for a mesh radio:



The settings on this tab are used to prevent WDS (Wireless Distribution System) connections from forming between specific radios. This allows you to disable the generation of weak or undesirable links. This can help with network stability and throughput.

The following tables describe the settings found in each group in the MAC Access tab.

MAC Access Settings	
Field Name	**Description**
Limit connections to links with RSSI greater than...	If checked, WDS connections will not form if the signal strength is less than the specified value. This option is useful for weeding out weak or intermittent links that can affect the performance of your network. If not checked, WDS connections will form, regardless of the quality of the signal.

MAC Access Setup	
Field Name	**Description**
Allowed MAC Addresses	This list contains the list of WDS links that are currently active.
	Click on the **Disallow** button to disallow specific WDS links. The links will be transferred from the **Allowed MAC Addresses** list to the **Disallowed**

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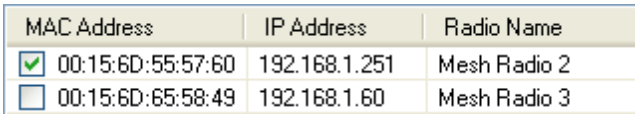
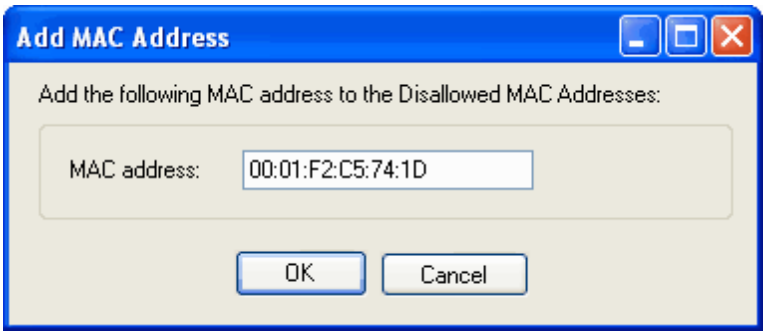
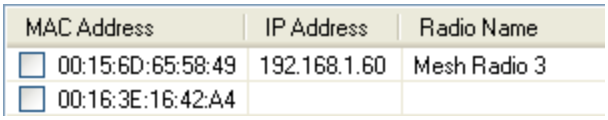
(Disallow button)	**MAC Addresses** list. Disallowed links will no longer be allowed to form. To disallow specific dynamic WDS links: 1. Select one or more links in the **Allowed MAC Addresses** table. To select a link, check the associated check box. In the following example, the first WDS link is selected  2. Click on the **Disallow** button to disallow the selected MAC addresses.
Disallowed MAC Addresses	This list contains the list of WDS links that are not allowed to form.
 (Add button)	Click on the Add button to manually add the MAC address of a remote radio to the disallowed list. When selected, the following form is displayed:  Specify the MAC address of the radio you want to disallow, and press the OK button. The new MAC address will be added to the Disallowed MAC Addresses list. Note: If you add the MAC address for a radio that is not known to ENCOM STRATOS, only the MAC address will be displayed in the disallowed list. If the radio is known to STRATOS, the associated IP Address and radio name will be included. Both scenarios are shown in the following example: 
	Click on the **Remove** button to remove links from the disallowed list. To remove disallowed links:

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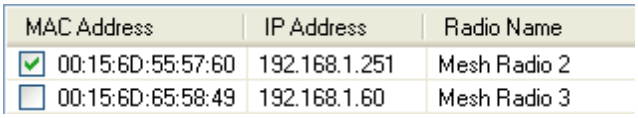
(Remove button)	1. Select one or more links in the **Disallowed MAC Addresses** table. To select a link, check the associated check box. In the following example, the first WDS link is selected:  2. Click on the **Remove** button to remove the selected links. In order for the newly allowed links to form, you have to save the updated configuration to the radio.

The following table describes the information that is displayed in the Allowed and Disallowed MAC address tables:

Column	Description
MAC Address	The MAC address of the wireless radio module on the remote radio.
IP Address	The IP address of the remote radio.
Radio Name	The name assigned to the remote radio.
Interface	Identifies the wireless radio module on the remote radio. The first radio module is **Radio 1**, the second radio module is **Radio 2**, etc.
Tx/Rx Strength	The transmit and receive signal strengths, in dBm, of the wireless connection between this radio and the remote radio.

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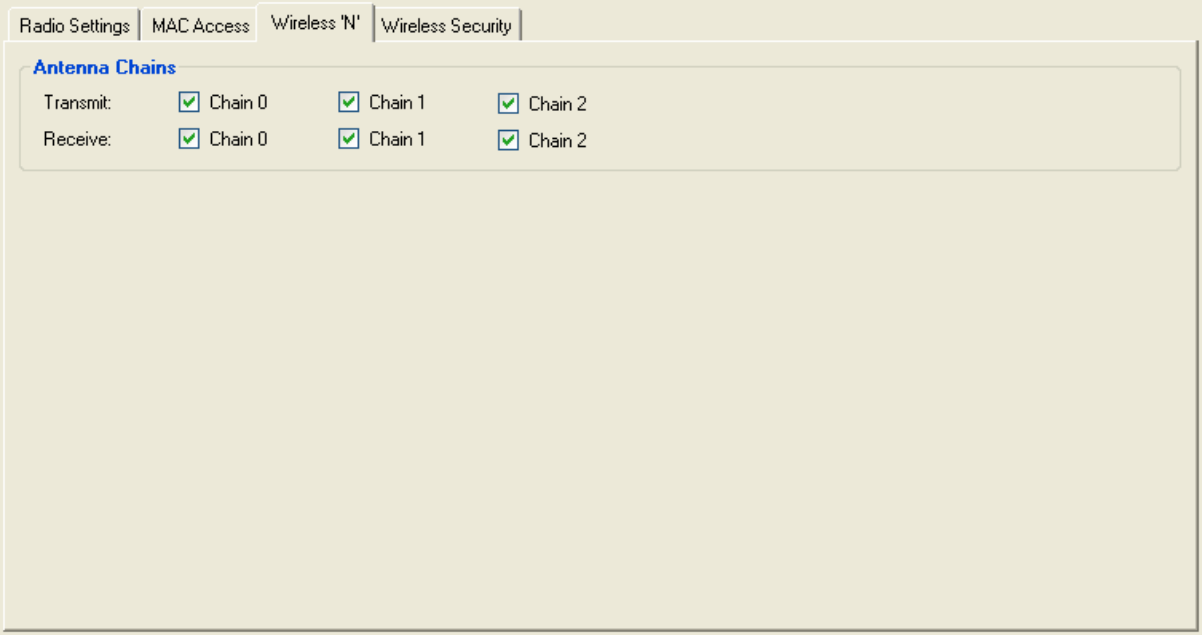
Wireless 'N' Settings

Note that the Wireless 'N' settings tab is only displayed if the associated radio card supports Wireless N operation.

The following screen shot shows the wireless 'N' settings tab for a mesh radio:



ENCOM offers Wireless-N radio cards that support up to 3 antennas. STRATOS will automatically display the number of antennas that are supported by your radio in the *Antenna Chains* group.

The following table describes the settings found in each group in the wireless 'N' settings tab.

Antenna Chains	
Field Name	**Description**
Transmit	Specify the antennas to use for transmitting data. Check the **Chain** option to enable the associated antenna, and uncheck it to disable the antenna. For optimal performance, you should enable all of the antennas supported by your radio card.
Receive	Specify the antennas to use for receiving data. Check the **Chain** option to enable the associated antenna, and uncheck it to disable the antenna. For optimal performance, you should enable all of the antennas supported by your radio card.

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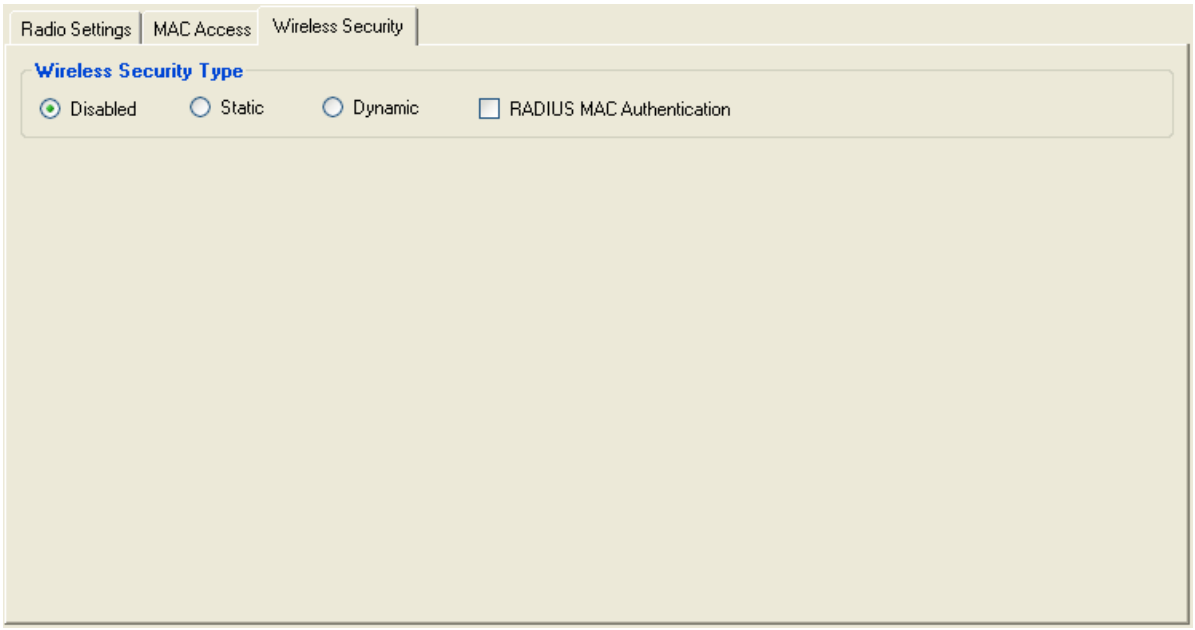
Wireless Security Settings

The following screen shot shows the wireless security settings tab for a mesh radio:



The Wireless Security Type group allows you to specify the security protocols used to protect the wireless communication links. You can choose from the following options:

Wireless Security Types	
Option	**Description**
Disabled	Select this option if you do not want to enable security. This option is not recommended since it allows anyone that has knowledge of the Network's SSID to connect to the network.
Static	This option enables wireless encryption that uses static keys. This is an older technology that is not as secure as the Dynamic option. It can, however, provide for a more stable network.
Dynamic	This option enables wireless encryption that uses dynamically allocated keys. This option provides the most secure communication link.
RADIUS MAC Authentication	Check this option if you use a RADIUS server for authentication. A Remote Authentication Dial in User Service (RADIUS) server acts as a centralized access and authorization point for network service. The authentication service is then handled by the RADIUS server instead of the ENCOM radios.

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Important: The security settings must be the identical for all radios on the network. Radios that have different security settings will not be able to communicate with each other.

Note: Encom Wireless Data Solutions highly recommends that you confer with your I.T. department to determine the appropriate level of security for your network.

The Static and Dynamic security options contain additional settings that need to be configured. The following topics describe these in more detail:

- Static Security Options
- Dynamic Security Options

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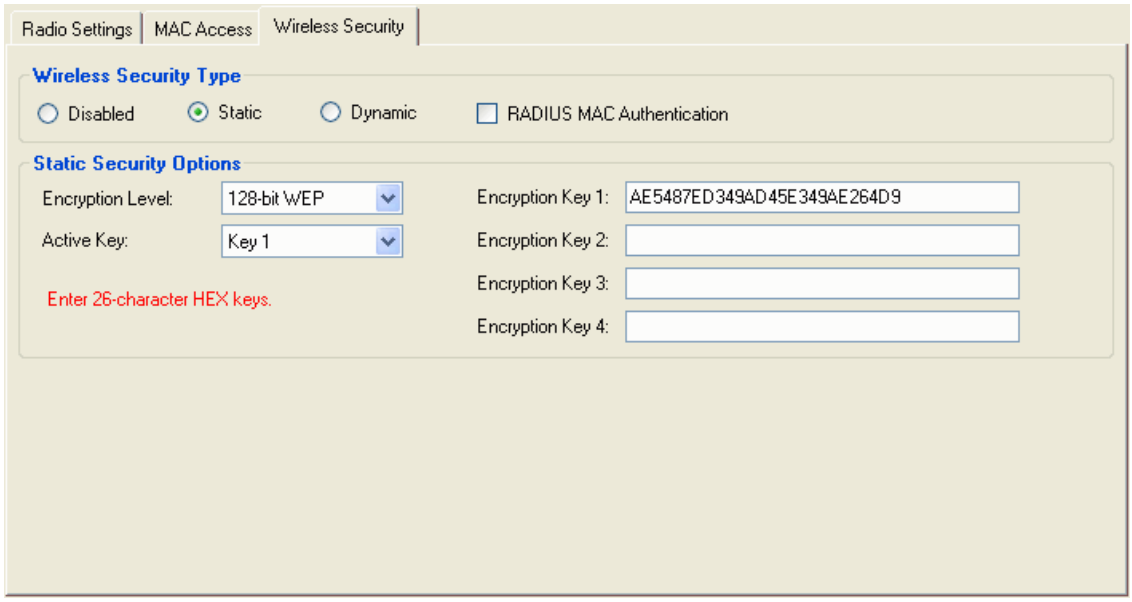
Static Security Settings

The following screen shot shows the static security options for a mesh radio:



The following table describes the static security options found in the Wireless Security Settings tab:

Static Security Options	
Field Name	**Description**
Encryption Level	Select the encryption level to use. Three options are available:

Option	Description
64-bit WEP	Uses a 40-bit encryption key coupled with a 24-bit initialization vector. This option is considered to be obsolete, and should only be used for compatibility with existing infrastructure.
128-bit WEP	Uses a 104-bit encryption key coupled with a 24-bit initialization vector. This option is more secure than 64-bit WEP, but still suffers from deficiencies in the WEP algorithm. It should only be used for compatibility with existing infrastructure.
128-bit AES	Uses the 128-bit AES block encryption algorithm couple with the CBC-MAC block chaining technique for added security. This is the most secure of the three static security options.

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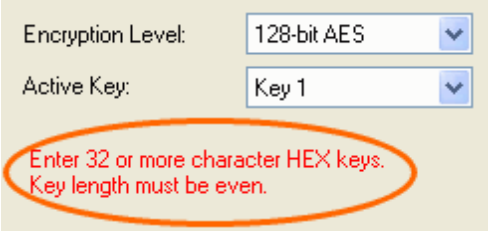
Static Security Options	
Field Name	**Description**
Active Key	Select the encryption key to use. Although you can define up to four static encryption keys, only one key can be active.
Encryption Key (1-4)	Enter the hexadecimal character sequence to use for the encryption key. Hexadecimal characters include the decimal digits (0-9) and the letters A-F. The number of characters you need to enter depends on the **Encryption Level** you have specified. An indicator, located below the **Active Key** list, will indicate the number of characters you have to enter: 

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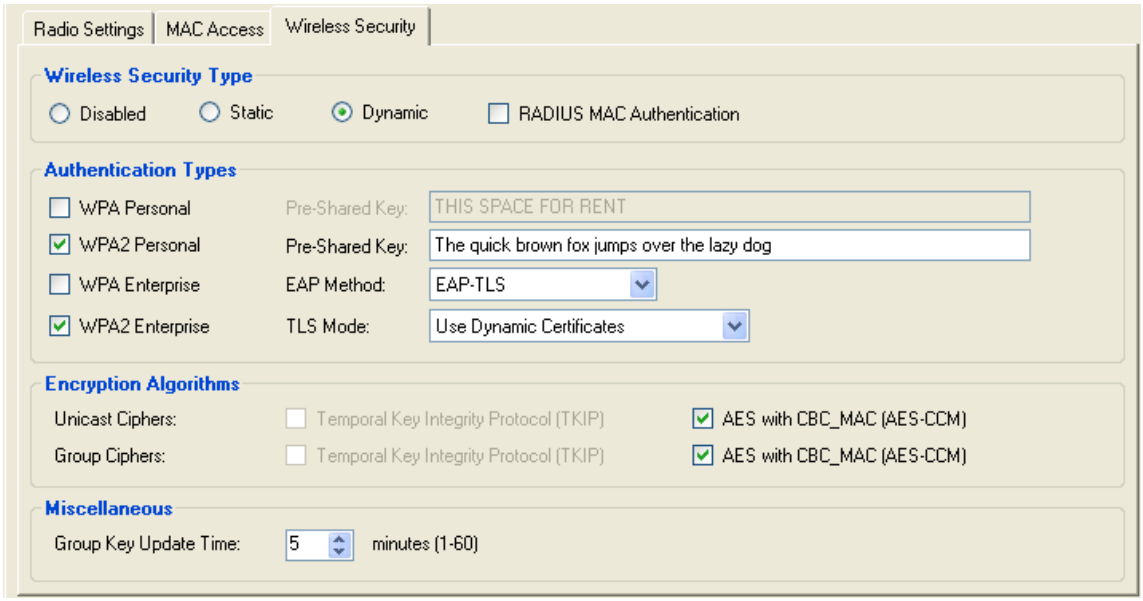
Dynamic Security Settings

The following screen shot shows the dynamic security options for a mesh radio:



The following tables describe the dynamic security options found in the Wireless Security Settings tab:

Authentication Types	
Field Name	**Description**
WPA Personal	Check this option to enable WPA personal authentication. You must also enter a pre-shared key used for the authentication process.
WPA2 Personal	Check this option to enable WPA2 personal authentication. You must also enter a pre-shared key used for the authentication process.
WPA Enterprise	Check this option to enable WPA enterprise authentication. This option does not require a pre-shared key.
WPA2 Enterprise	Check this option to enable WPA2 enterprise authentication. This option does not require a pre-shared key.
EAP Method	Specify the authentication protocol to use. Two options are available:

Option	Description
Pass Through	Authentication requests are relayed to a RADIUS server.
EAP-TLS	TLS certificates are used for authentication.

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	This option is only used by the WPA Enterprise and WPA2 Enterprise authentication types. It is hidden if no enterprise option is selected.
TLS Mode	Specify how TLS certificates are to be used. Two options are available: **Option** / **Description** Use Dynamic Certificates: TLS certificates are negotiated dynamically using anonymous Diffie-Hellman MODP 2048 bit algorithm. Use Imported Certificates: A TLS certificate that has been imported into the radio is used. This option is only used when the **EAP Method** is set to EAP-TLS. It is hidden if the EAP-TLS option is not selected.

Encryption Algorithms

Field Name	Description
Unicast Ciphers	Check the ciphers that can be used to encrypt frames sent to individual radios. Two options are available. **Option** / **Description** AES-CCM: A more secure WPA encryption protocol, based on the reliable AES (Advanced Encryption Standard). Use this option is preferred if the there are no legacy WEP devices in the network. This TKIP option is not available in mesh devices.
Group Ciphers	Check the ciphers that can be used to encrypt frames broadcast to all radios. Two options are available. **Option** / **Description** AES-CCM: A more secure WPA encryption protocol, based on the reliable AES (Advanced Encryption Standard). Use this option is preferred if the there are no legacy WEP devices in the network. This TKIP option is not available in mesh devices.

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Miscellaneous	
Field Name	**Description**
Group Key Update Time	The interval at which the dynamically generated keys are updated.

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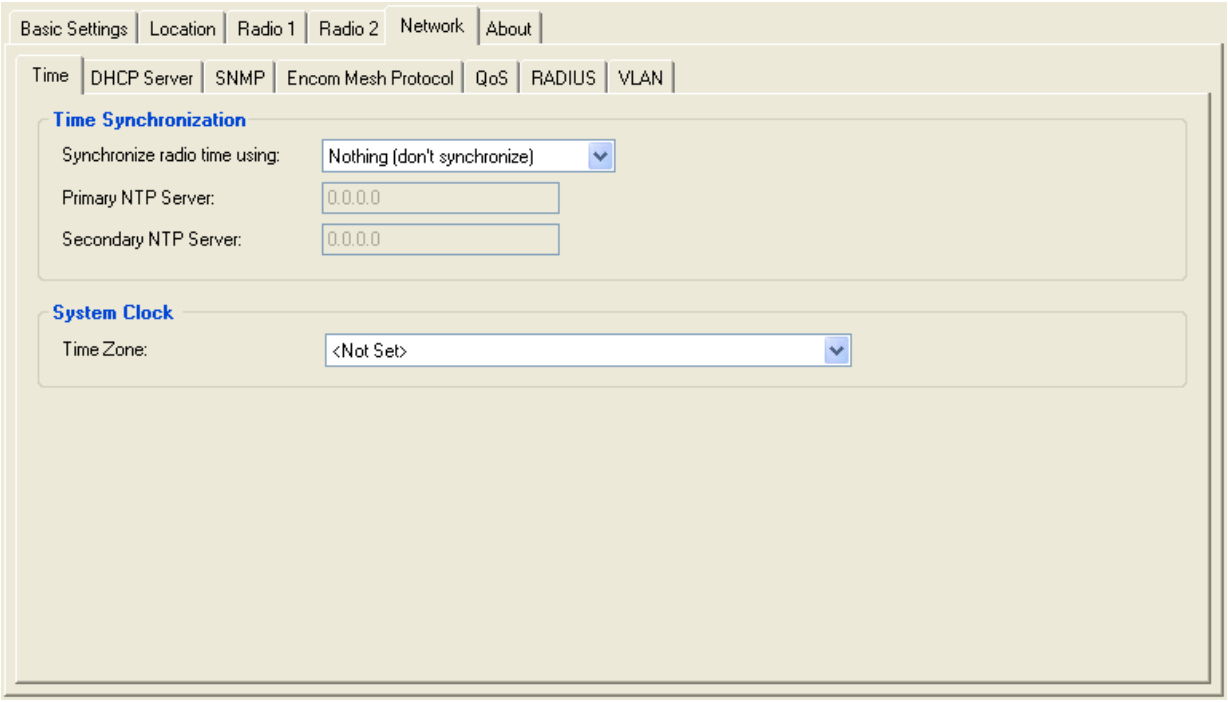
Network Tab

The following screen shot shows the network settings tab for a mesh radio:



Because a large number of configuration options are available, the network configuration tab is split up into a number of sub-tabs. The following topics describe the settings found in each sub-tab:

- Time Settings
- DHCP Server Settings
- SNMP Settings
- Encom Mesh Protocol Settings
- QoS (Quality of Service) Settings
- RADIUS Settings
- VLAN Settings

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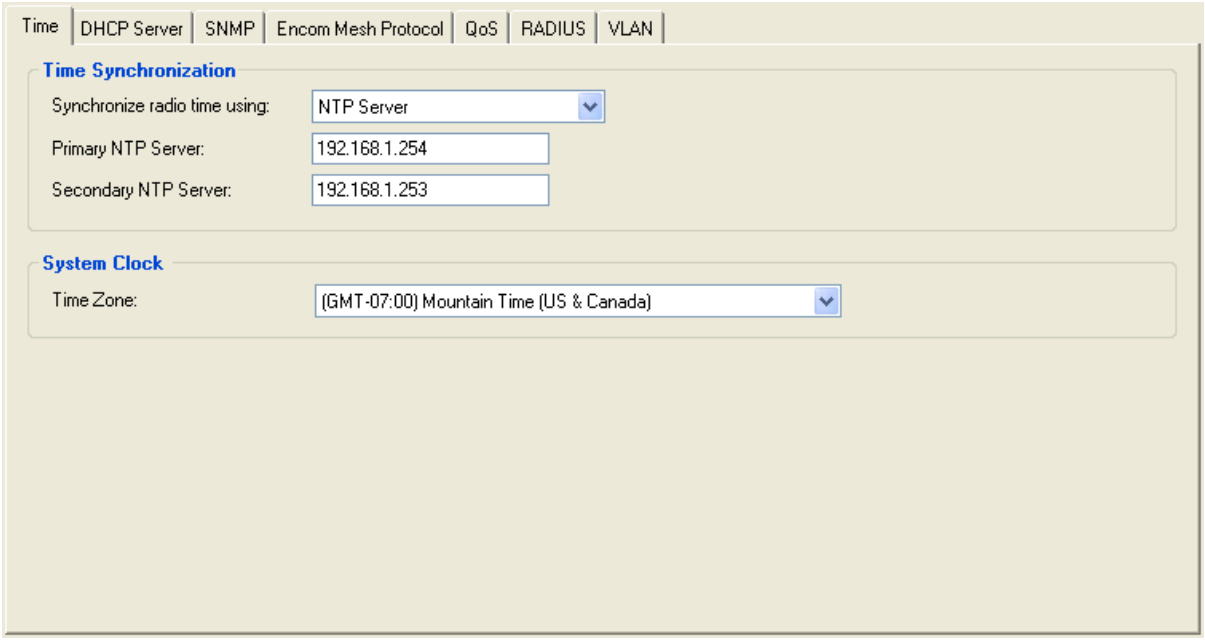
Time Settings

The following screen shot shows the NTP settings tab for a mesh radio:



The following table describes the time synchronization settings.

Time Synchronization	
Field Name	**Description**
Synchronize radio time using	Select one of the following options to set the system clock: **Option** / **Description** Nothing — The radio's time will only be synchronized when a configuration change is made by STRATOS. NTP Server — The radio will synchronize its internal clock to the specified NTP server time at regular intervals. GPS Receiver — The radio will synchronize its internal clock from the built-in GPS receiver. **Note:** This option is only available if the radio contains a GPS receiver.
Primary NTP Server	Specify the IP address of the NTP server used to synchronize the radio's internal clock. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:

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	 Note: This option is only enabled when the NTP Server option is selected.
Secondary NTP Server	If applicable, specify the IP address of the secondary NTP server. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If there is no secondary NTP server in your network, enter "0.0.0.0" in this field. **Note:** This option is only enabled when the NTP Server option is selected.

System Clock	
Field Name	**Description**
Time Zone	Select the time zone in which the radio is operating. Note that the time zone has no effect on the operation of the radio, and does not need to be set for normal operation. If the time zone is not set, the radio defaults to UTC time.

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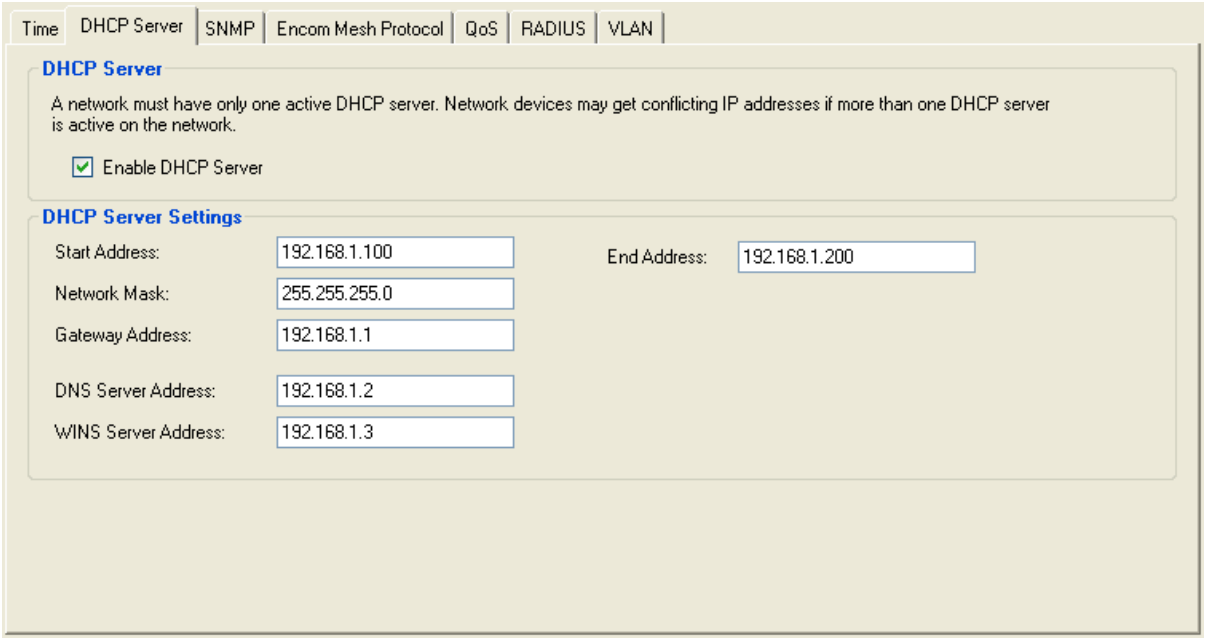
DHCP Server Settings

The following screen shot shows the DHCP server tab for a mesh radio:



The following table describes the DHCP server settings.

DHCP Server	
Field Name	**Description**
Enable DHCP Server	Check this option to enable the radio's DHCP server. When this option is enabled, the radio will assign IP addresses to any other radio, or any other other device, that is configured to obtain their IP addresses dynamically. **Important:** Severe network instability can occur if there is more than one DHCP server present in a network or network segment. Do not enable this option if a router or another radio is already acting as a DHCP server.

DHCP Server Settings	
Field Name	**Description**
DHCP Address Range	Specify the start and end range of the IP addresses that will be provided by the DHCP server, as shown in the following example:

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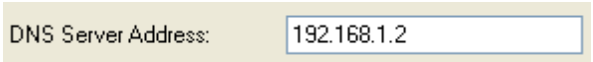
DHCP Server Settings	
Field Name	**Description**
	 In this example, IP addresses in the 192.168.1.100 - 192.168.1.200 range will be assigned to devices that use dynamic addressing. IP addresses outside this range would be manually assigned to devices that do not use dynamic addressing.
Network Mask	Enter the network mask that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:
Gateway Address	Enter the IP Address of the default gateway that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: The default gateway is the radio or router that provides access to devices outside of the local network.
DNS Server Address	Enter the IP Address of the DNS server that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:  If there is no DNS server available in your network, enter "0.0.0.0" in this field.
WINS Server Address	Enter the IP Address of the WINS server that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If there is no WINS server available in your network, enter "0.0.0.0" in this field.

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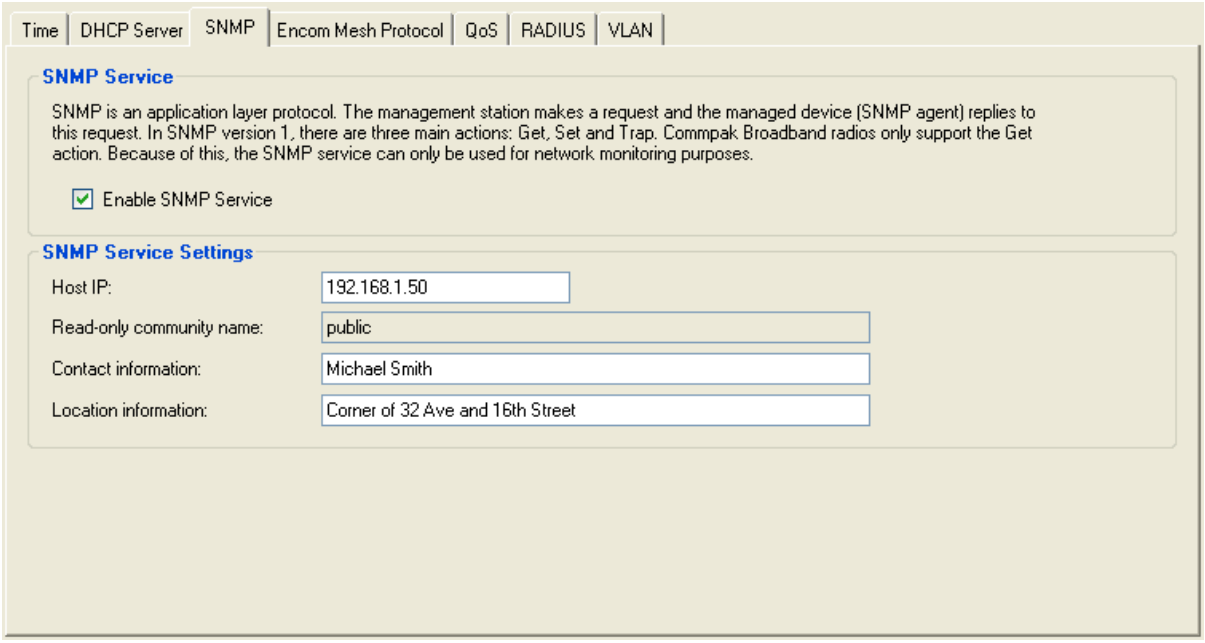
SNMP Settings

The following screen shot shows the SNMP tab for a mesh radio:


Time
DHCP Server
SNMP
Encom Mesh Protocol
QoS
RADIUS
VLAN
SNMP Service
SNMP is an application layer protocol. The management station makes a request and the managed device (SNMP agent) replies to this request. In SNMP version 1, there are three main actions: Get, Set and Trap. Commpak Broadband radios only support the Get action. Because of this, the SNMP service can only be used for network monitoring purposes.
Enable SNMP Service
SNMP Service Settings
Host IP:
192.168.1.50
Read-only community name:
public
Contact information:
Michael Smith
Location information:
Corner of 32 Ave and 16th Street

The following tables describe the SNMP service settings.

SNMP Service	
Field Name	**Description**
Enable SNMP Service	Check this option enable the radio's SNMP (Simple Network Management Protocol) agent. When this option is enabled, diagnostic information can be obtained from the radio using any SNMP based network monitoring application.

SNMP Service Settings	
Field Name	**Description**
Host IP	Enter the IP address of the computer on which the network monitoring application is running, as shown in the following example: Host IP: 192.168.1.50 Setting this option will prevent any other computer from being able to access the radio's SNMP information. If you want to allow any computer that is on your network to access the radio's SNMP information, enter "0.0.0.0" in this field.

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Community Name	The community name used to access the radio's SNMP agent. This is set to 'public', and cannot be changed. Only read operations are permitted.
Contact Information	Enter the contact information of the individual responsible for the network, if applicable.
Location Information	Enter the location of the radio, if applicable.

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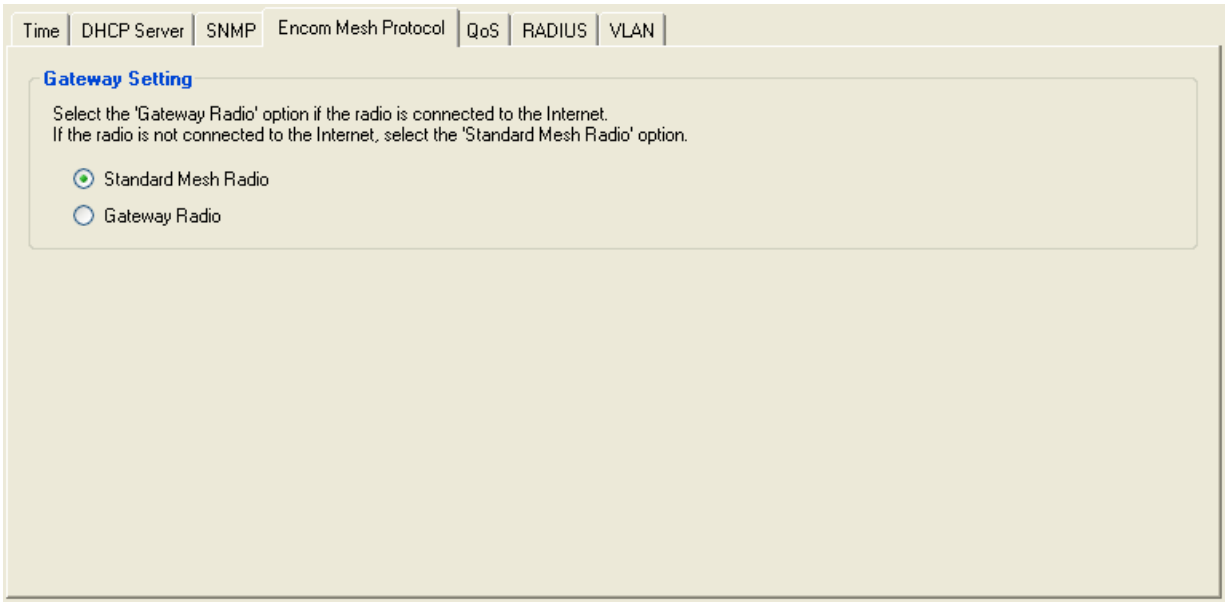
Encom Mesh Protocol Settings

The following screen shot shows the Encom Mesh Protocol tab for a mesh radio:



The following table describes the *Encom Mesh Protocol* settings.

Gateway Settings	
Field Name	**Description**
Standard Mesh Radio	Select this option of the radio is not physically connected to the Internet.
Gateway Radio	Select this option if the radio is physically connected to the network operations center via its Ethernet port. This setting is appropriate when data typically flows from deployed radios, through the the gateway, to the network operations center. It is not recommended when most of the traffic is meant to flow from one deployed radio to another. **Note:** Do not select this option if the radio is not connected via its Ethernet port. Doing so may cause severe network instabilities.

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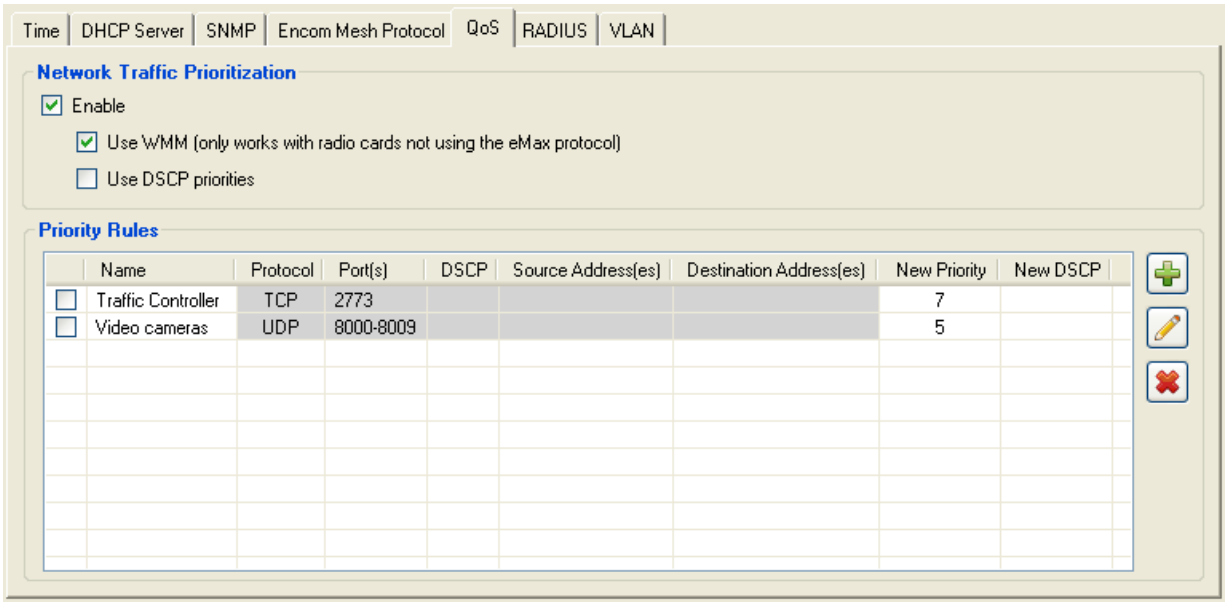
QoS Settings

The following screen shot shows the *QoS (Quality of Service)* settings tab for a mesh radio:



The Quality of Service settings allow you to prioritize the various types of network traffic so that important traffic is processed ahead of less important traffic.

Under normal conditions, all network data packets have an equal opportunity to be forwarded by the radio. This works well for some applications (such as file transfers or web browsing) but it is not adequate for traffic that is sensitive to network latency and throughput reductions (such as voice or video streaming). QoS allows you to address this issue by giving the time sensitive traffic a larger share of the network bandwidth.

Refer to Appendix D: Quality of Service for more detailed information on the prioritization mechanisms supported by the ENCOM radios.

The following tables describe the Quality of Service settings.

Network Traffic Prioritization	
Field Name	**Description**
Enable	Check this option to enable priority queue based QoS features. Priority rules are used to specify the priority of specific types of traffic. Lower priority traffic is dropped in preference to higher priority traffic when the radio becomes heavily loaded.
Use WMM	Check this option to set the priority of incoming packets to the incoming WMM priority (or to the incoming VLAN priority if VLANs are being used). WMM is used to prioritize certain type of traffic, such as VOIP (Voice Over IP) and video streams, that are sensitive to network latency and capacity

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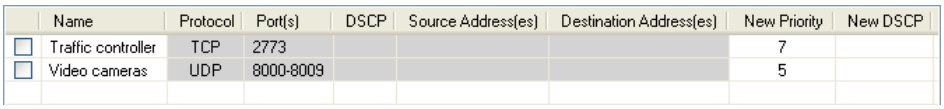
	issues. **Note:** The WMM/VLAN priorities must be set by the device that creates the network data packets or by the router or switch that provides access to the ENCOM radio network.
Use DSCP Priorities	Check this option to set the priority of incoming packets to the DSCP priority of the incoming data packets. **Note:** The DSCP priorities must be set by the device that creates the network data packets or by the router or switch that provides access to the ENCOM radio network.

Priority Rules

Field Name	Description
Priority Rule List	By default, ENCOM STRATOS will assign the highest priority to the radio management traffic. Other types of network traffic can be assigned to specific priority queues by creating custom priority rules. The **Priority Rules** list displays the custom priority rules that you have defined. When defining a priority rule, you specify the type of traffic that the rule is to act upon, and the priority to assign to the matching traffic. In the following example, two priority rules have been defined:



	Name	Protocol	Port(s)	DSCP	Source Address(es)	Destination Address(es)	New Priority	New DSCP
☐	Traffic controller	TCP	2773				7	
☐	Video cameras	UDP	8000-8009				5	

The shaded cells contain the criteria that must be matched in order for a network data packet to be affected by the rule. Matching data packets will be assigned the **New Priority** (and optionally the **New DSCP** value) defined in the rule.

The priority rule list is sorted by the **New Priority** column, in descending order.

The following table describes the information that is displayed in the **Priority Rules** list:

Column	Description
☐	To delete a rule, first check it, and then click on the **Remove** button at the right of the **Priority Rule** list to actually delete it.
Name	A short description that identifies the type of

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	<table><tr><td></td><td>network traffic associated with the rule.</td></tr><tr><td>Protocol</td><td>The protocol to match.</td></tr><tr><td>Port(s)</td><td>The IP port or ports to match. If blank, traffic on any port is affected by the rule.</td></tr><tr><td>Source Address(es)</td><td>The address or addresses that the data packets must originate from.</td></tr><tr><td>Destination Address(es)</td><td>The address or addresses that the data packets are being forwarded to.</td></tr><tr><td>DSCP</td><td>The DSCP value of the incoming packets to match. If blank, the DSCP priority is ignored by the rule.</td></tr><tr><td>New Priority</td><td>The priority to assign to the packets that match the specified criteria.</td></tr><tr><td>New DSCP</td><td>The DSCP value to assign to the packets that match the specified criteria.</td></tr></table>
(Add button)	Click the **Add** button to create a new priority rule. Enter the appropriate rule settings in the QoS Priority Rule form that is displayed.
(Edit button)	Select a priority rule, and then click on the **Edit** button to modify the rule settings. Alternatively, you can double-click on the rule you want to modify.
(Remove button)	To delete a rule, first check it, and then click on the **Remove** button to actually delete it.

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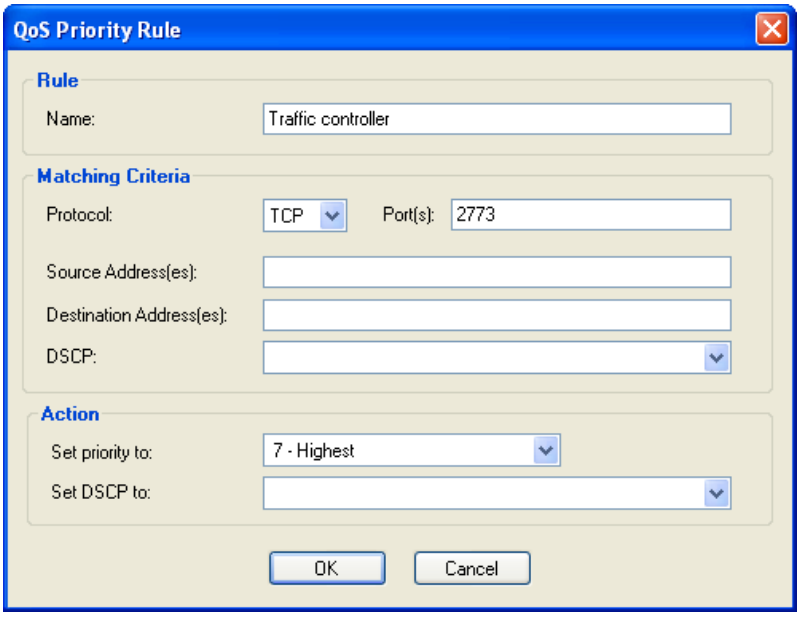
Specifying a QoS Priority Rule

The following screen shot shows the *QoS Priority Rule* form for a mesh radio:



The *QoS Priority Rule* form allows you to define a traffic priority rule.

The following tables describe the QoS rule settings.

Rule	
Field Name	**Description**
Name	Enter a short description that identifies the type of network traffic associated with the rule.

Matching Criteria	
Field Name	**Description**
Protocol	Specify the protocol that the rule will apply to. You can select one of the following values: **Protocol** / **Description** All / All network traffic will be matched. When you select this option, one or both of the **Source Address** and **Destination Address** fields must be set. Otherwise, all of the network traffic flowing through the radio would match the

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<table>
<tr><td></td><td>
<table>
<tr><td></td><td>rule.</td></tr>
<tr><td>UDP</td><td>The rule will only affect UDP traffic.</td></tr>
<tr><td>TCP</td><td>The rule will only affect TCP traffic.</td></tr>
</table>
</td></tr>
<tr><td>Ports</td><td>Optionally specify the port or ports associated with the network traffic that the rule will apply to. You can specify the ports using one of the following formats:
<table>
<tr><th>Format</th><th>Example</th></tr>
<tr><td>Single Port</td><td>1000</td></tr>
<tr><td>Multiple Ports</td><td>1000,2000</td></tr>
<tr><td>Port Range</td><td>1000-2000</td></tr>
<tr><td>Multiple Port Ranges</td><td>1000-2000,3000-4000</td></tr>
</table>
If this value is not specified, the rule will apply to all traffic of the selected protocol type.</td></tr>
<tr><td>Source Address(es)</td><td>Optionally specify the address or addresses that the data packets must originate from. You can specify the addresses using one of the following formats:
<table>
<tr><th>Format</th><th>Example</th></tr>
<tr><td>Single IPV4 Address</td><td>192.168.1.100</td></tr>
<tr><td>IPV4 Address Range</td><td>192.168.1.100-192.168.1.200</td></tr>
<tr><td>IPV4 CIDR Subnet</td><td>192/168.1.1/24</td></tr>
</table>
If this value is not specified, the rule will apply to all destination addresses.</td></tr>
<tr><td>Destination Address(es)</td><td>Optionally specify the address or addresses that the data packets are being forwarded to. You can specify the addresses using one of the following formats:
<table>
<tr><th>Format</th><th>Example</th></tr>
<tr><td>Single IPV4 Address</td><td>192.168.1.100</td></tr>
</table></td></tr>
</table>

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	<table><tr><td>IPV4 Address Range</td><td>192.168.1.100-192.168.1.200</td></tr><tr><td>IPV4 CIDR Subnet</td><td>192/168.1.1/24</td></tr></table> If this value is not specified, the rule will apply to all destination addresses.
DSCP	Optionally specify the DSCP (Differentiated Services Code Point) value in the IP header that the rule will apply to. You can select a predefined DSCP value from the drop-down list, or enter a number between 0 and 63. If this value is not specified, the rule will apply to all DSCP values.

Action	
Field Name	**Description**
Set priority to	The priority to assign to the packets that match the specified criteria. The higher the priority value, the higher the priority assigned to the associated network traffic.
Set DSCP to	Optionally specify the DSCP (Differentiated Services Code Point) value to assign to the packets that match the specified criteria. You can select a predefined DSCP value from the drop-down list, or enter a number between 0 and 63. If this value is not specified, no change will be made to the packet's DSCP value.

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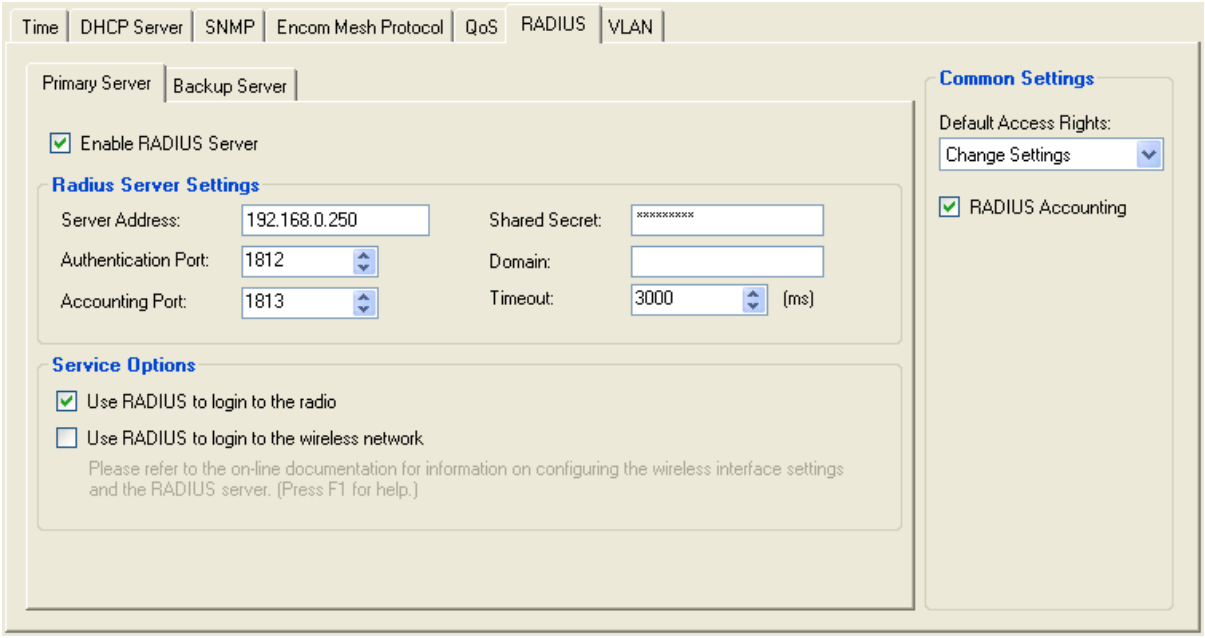
RADIUS Settings

The following screen shot shows the *RADIUS* settings tab for a mesh radio:



RADIUS is used to centralize the authentication of users that attempt to login to the radio and/or to the network. Refer to **ENCOM STRATOS RADIUS Configuration Guide**, available separately, for more information on setting up and using a RADIUS server with your radio network.

The following tables describe the settings found in each group in the RADIUS settings tab.

Primary and Secondary Server	
Field Name	**Description**
Enable RADIUS Server	Check this setting to enable the associated RADIUS server (Primary or Backup). If the radio cannot connect to the primary RADIUS server, it will attempt to connect to the backup RADIUS server.
Server Address	Enter the IP address of the RADIUS server.
Authentication Port	Enter the IP port on which RADIUS authentication requests are accepted. The default is 1812.
Accounting Port	Enter the IP port on which RADIUS accounting updates are accepted. The default is 1813.
Shared Secret	Enter a string that is used to obfuscate the user password that is sent to the RADIUS server for authentication. This value must match the Shared Secret that is configured in the RADIUS server.

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Domain	Enter the Microsoft Windows domain of the user. Only use if the RADIUS server requires domain validation.
Timeout	Enter the maximum amount of time (in milliseconds) to wait for a response from the RADIUS server before resending an authentication request. The default is 300 ms. You may need to increase this if your RADIUS server is slow to respond to authentication requests.
Use RADIUS to login to the radio	Check this option to use RADIUS to authenticate radio login requests. When this option is enabled, the radio will check with the RADIUS server if it does not find the specified user in its local user database.
User RADIUS to login to the wireless network	Check this option to use RADIUS to authenticate client devices that wish to attach to your network (e.g. for access to the network operations center or to your corporate LAN). If you select this option, you will need to check the RADIUS MAC Authentication setting for each of the radio cards that clients will use to connect to the network.

Common Settings

Field Name	Description
Default Access Rights	Select the access rights to assign to the user if the RADIUS server is not configured to respond to an authentication request with the user's group name. The following table describes the options that are available for this setting: **Option** / **Description** View Settings — The user will be able to inspect the radio's configuration settings, but will not be able to make any changes. Change Settings — The user will be able to inspect and change the radio's configuration settings. This setting is ignored if the RADIUS server responds to an authentication request with the user's group name.
RADIUS Accounting	Check this option to send RADIUS accounting packets to the RADIUS server. This information is normally used for user billing, and is not usually needed for typical ENCOM radio networks.

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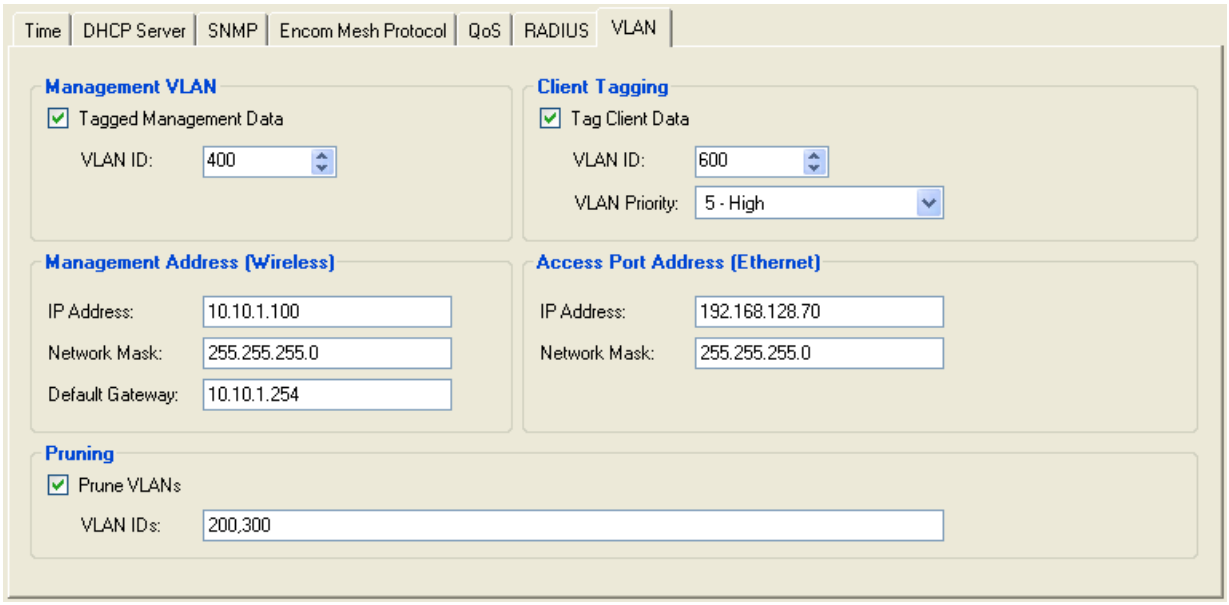
VLAN Settings

The following screen shot shows the *VLAN* settings tab for a mesh radio:



VLANs (Virtual LANs) are used to improve the performance, and possibly the security, of a radio network. Refer to Appendix E: VLAN Support for more information on implementing a VLAN-based network.

The following tables describe the settings found in each group in the VLAN settings tab.

Management VLAN	
Field Name	**Description**
Tagged Management Data	By default, the radio can be managed by connections over the native (non-tagged) VLAN. To be able to manage the radio using a specific VLAN, check this option, and enter the appropriate management VLAN ID in the **VLAN ID** field.
VLAN ID	Enter the ID of the management VLAN (a number in the range 1-4095 is required).

Client Tagging	
Field Name	**Description**
Tag Client Data	Normally, all of the radio's interfaces (wireless and Ethernet) act as VLAN trunks (i.e. they carry the network traffic for all VLANs). If a normal, non-VLAN aware device is plugged into the radio's Ethernet port, its network traffic will not be tagged, and it will not be able to communicate with

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	devices that are part of a VLAN. Check this option to set up the radio's Ethernet port as an access port for a specific VLAN. This gives devices connected to the Ethernet port access to the other devices in the specified VLAN.
VLAN ID	Enter the ID of the client VLAN to (a number in the range 1-4095 is required).
VLAN Priority	The priority to assign to the packets originating from the Ethernet port. The higher the priority value, the higher the priority assigned to the associated network traffic. **Note:** In order to prioritize the wireless network traffic using the VLAN priority, the appropriate QoS options need to be configured. See the Using WMM to Support VLAN Priority Traffic topic for more information.

Management Address (Wireless)	
Field Name	**Description**
IP Address	Enter the IP address used to access the radio via its wireless interfaces. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tagged Management Data** option is checked, this IP address should be compatible with the management VLAN's network address range.
Network Mask	Enter the network mask of the network used to access the radio via its wireless interfaces. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tagged Management Data** option is checked, this mask should be compatible with the management VLAN's network mask.

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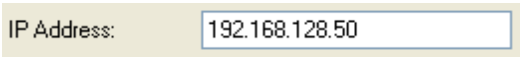
Default Gateway	Enter the IP address of the radio, router or switch that allows this radio to connect with devices that are outside of their local LAN or VLAN. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tagged Management Data** option is checked, this IP address would normally be the IP address of the network's gateway radio, or the IP address of the router or switch used to access external networks.

Access Port Address (Ethernet)	
Field Name	**Description**
IP Address	Enter the IP address used to access the radio via its Ethernet interface. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:  If the **Tag Client Data** option is checked, this IP address should be compatible with the client VLAN's network address range.
Network Mask	Enter the network mask of the network used to access the radio via its Ethernet interface. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tag Client Data** option is checked, this mask should be compatible with the client VLAN's network mask.

Pruning	
Field Name	**Description**
Prune VLANs	Check this option to prevent the radio for forwarding network traffic associated with specific VLAN IDs.
VLAN IDs	Enter one or more VLAN IDs to prune. Separate individual IDs with commas. Any incoming network traffic that matches the specified VLAN IDs will be dropped by the radio.

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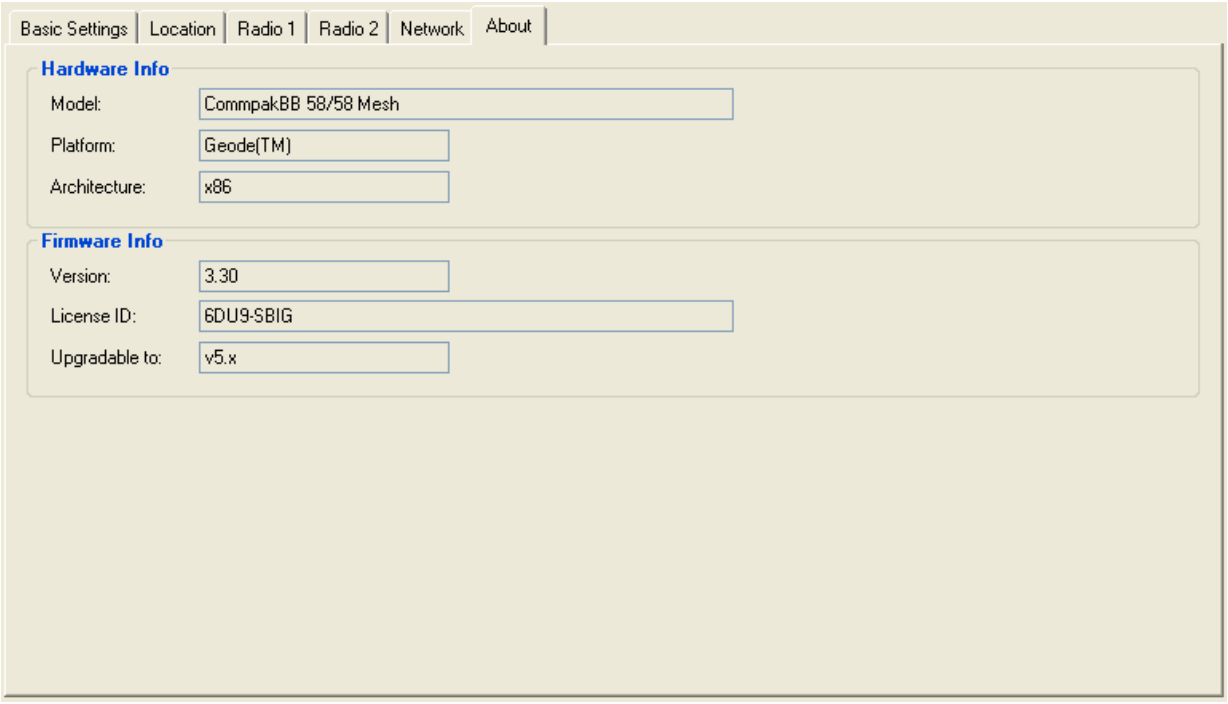
About Tab

The following screen shot shows the About tab for a mesh radio:



This tab displays information regarding the radio's hardware and firmware. It does not contain any user editable fields.

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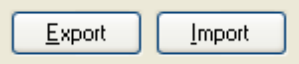
Export and Import Buttons

The **Export** and **Import** buttons in the lower left-hand corner of the radio configuration form allow you to save the radio's configuration settings to a file, and to update the radio's configuration settings from a previously saved configuration file.



Refer to the following topics for more information on these functions:

- Exporting the Radio Configuration
- Importing the Radio Configuration

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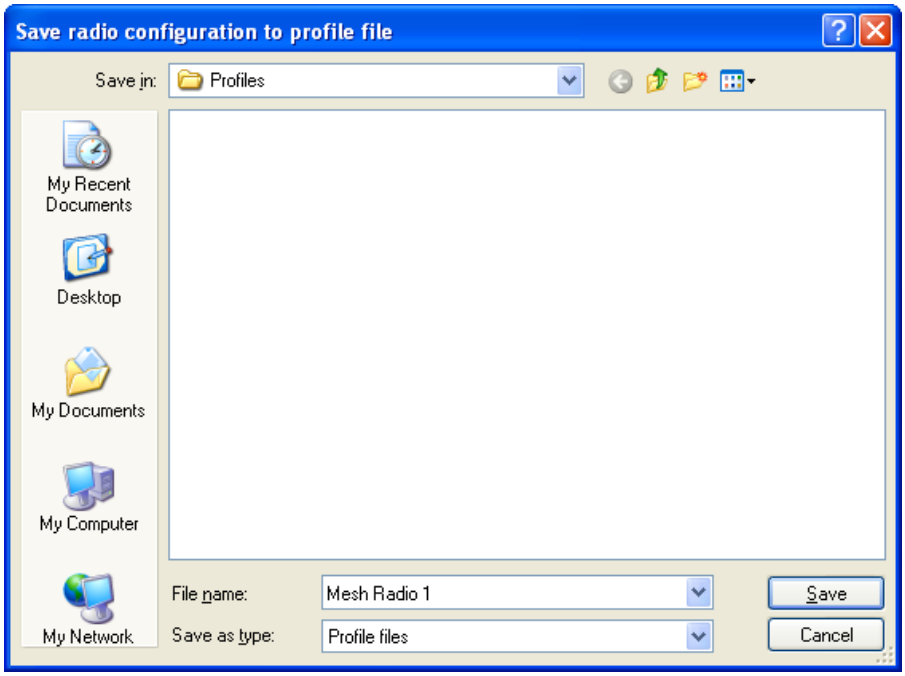
Exporting the Radio Configuration

The **Export** function is used to save the radio's current settings to a configuration profile file. This allows you to:

- Make a backup copy of the radio's configuration.
- Save the radio's configuration to a profile or template file for use in configuring other radios.

To export a radio's configuration:

1. From the radio's configuration form, click on the **Export** button. The *Save configuration profile file* form is displayed:



2. Specify the name of the file you want to save the radio's configuration settings to, and then press the **Save** button to save the settings.

   By default, STRATOS saves configuration profile files in the *'My Documents\Encom Wireless\Profiles'* folder.

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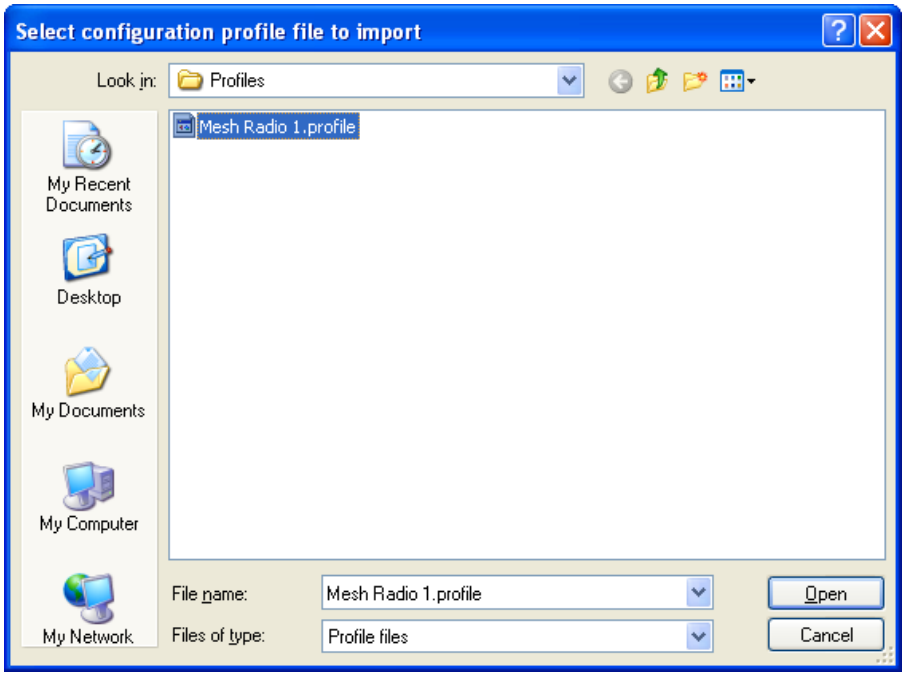
Importing the Radio Configuration

The **Import** function allows you to update the radio's settings from a previously saved configuration profile file. This function allows you to:

- Restore the radio's configuration from a backup file. This can be useful when you have to replace a radio in the field.
- Apply the settings from one radio to another. This can be used to provision new radios quickly, and ensure that they are compatible with other radios in the network.

To configure a radio using a saved configuration file:

1. From the radio's configuration form, click on the **Import** button. The *Select configuration profile file* form is displayed:



2. Select the configuration profile you want to import, and press the **Open** button.

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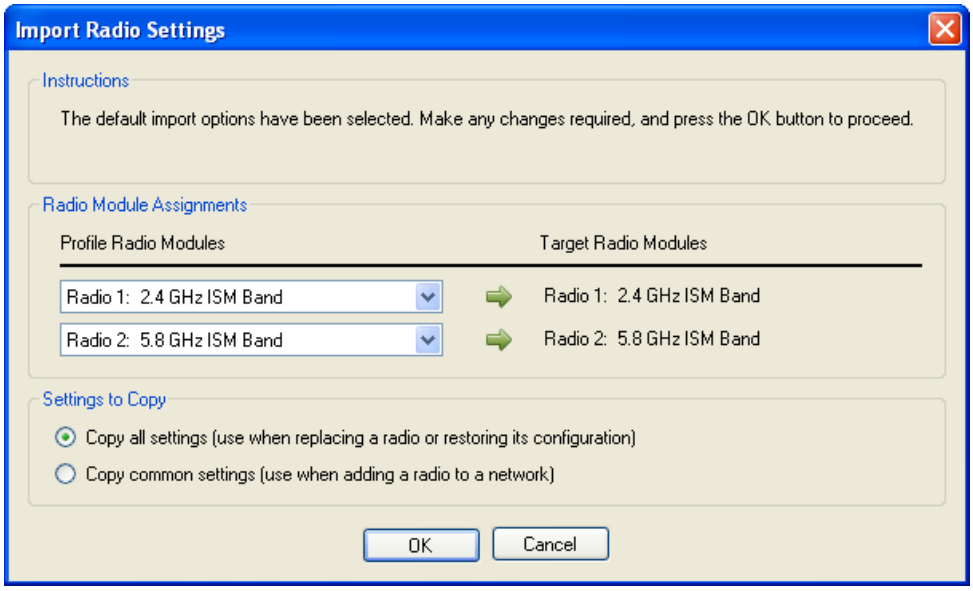
3. The *Import Radio Settings* form will be displayed:


Import Radio Settings
Instructions
The default import options have been selected. Make any changes required, and press the OK button to proceed.
Radio Module Assignments
Profile Radio Modules
Target Radio Modules
Radio 1: 2.4 GHz ISM Band
Radio 1: 2.4 GHz ISM Band
Radio 2: 5.8 GHz ISM Band
Radio 2: 5.8 GHz ISM Band
Settings to Copy
Copy all settings (use when replacing a radio or restoring its configuration)
Copy common settings (use when adding a radio to a network)
OK
Cancel

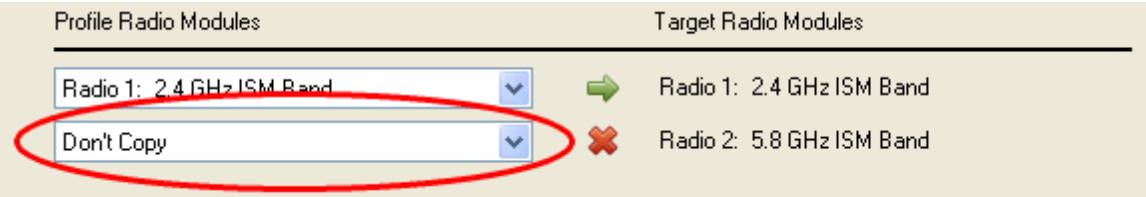
4. The *Radio Module Assignments* group allows you to specify how the radio module settings are applied:

Profile Radio Modules
Target Radio Modules
Radio 1: 2.4 GHz ISM Band
Radio 1: 2.4 GHz ISM Band
Radio 2: 5.8 GHz ISM Band
Radio 2: 5.8 GHz ISM Band

The **Target Radio Modules** column lists the wireless radio modules that are present on the radio.

The **Profile Radio Modules** column shows the options that are available for each wireless interface that is present on the radio. STRATOS will find the best match between the profile and target radio modules, and will assign these by default. You can change the default assignments by selecting the appropriate items from the list boxes.

In the example shown above, STRATOS applied the matching radio modules from the profile to the target radio modules. If you didn't want to disturb the configuration of the second radio module, then you would select the **Don't Copy** option from the second list box, as shown below:



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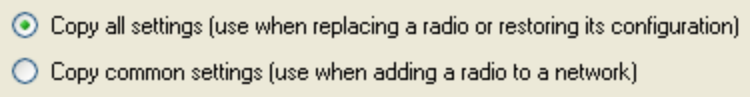
5. The **Settings to Copy** options allow you to specify what settings to import from the configuration profile:


Copy all settings (use when replacing a radio or restoring its configuration)
Copy common settings (use when adding a radio to a network)

These are described further in the following table:

Option	Description
Copy all settings	Use this option when you need to configure a radio so that it matches the configuration profile exactly. This option is most often used when configuring a replacement radio, or you want to restore the radio's configuration from a backup.
Copy common settings	Use this option to exclude those settings that are unique to the radio. This option is most often used when you are adding a new radio to a network, and you want to configure it to match the other radios in the network. The following items will **not** get copied over from the profile file to the radio: • Radio name • Radio Description • Radio latitude, longitude and street address • Radio static IP address • Disallowed MAC addresses

6. Press the **OK** button to apply the profile settings to the radio.
7. Make any changes to the imported settings in the radio configuration form.
8. Press the **Save** button on the radio configuration form to save the settings to the radio.

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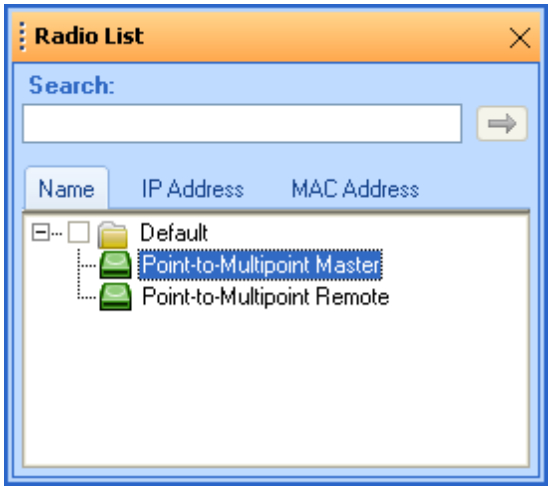
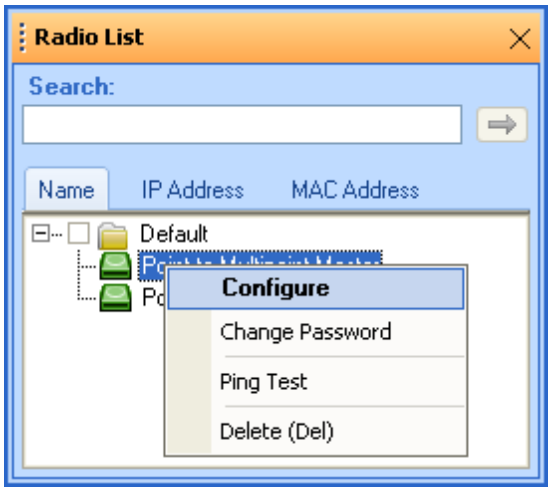
Configuring Point-to-Multipoint Radios

To configure a point-to-multipoint radio:

1. Locate the radio you would like to configure in the Radio List. Ensure that it is currently on-line (a green icon is displayed at the left of an on-line radio):



2. Click the right mouse button on the radio name, and select **Configure** from the pop-up menu that is displayed:



Alternatively, you can either double-click the left mouse button on the radio name, or click the left mouse button on the radio name, and select **Radio -> Configure** from the main menu.

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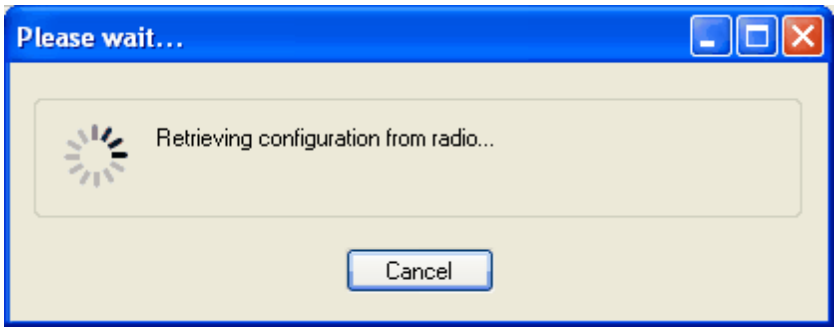
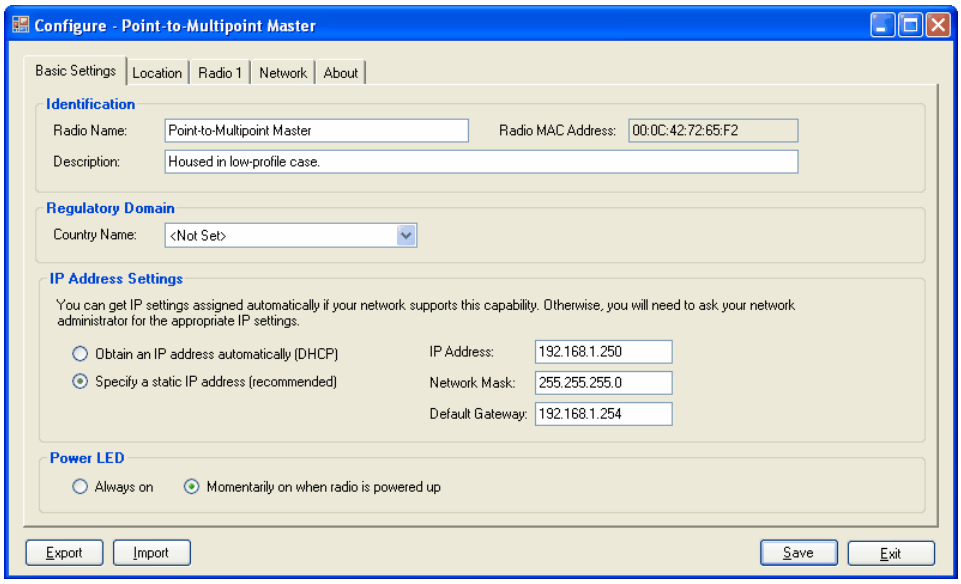
3. STRATOS will download the radio's current configuration. This process will normally take a few seconds to complete. During this time, a wait form is displayed:



4. When the radio's configuration has been obtained, the radio configuration form is displayed:



The configuration settings are logically grouped using a tabbed interface. The following topics describe the settings found in each tab:

- Basic Settings tab
- Location tab
- Radio tab
- Network tab
- About tab

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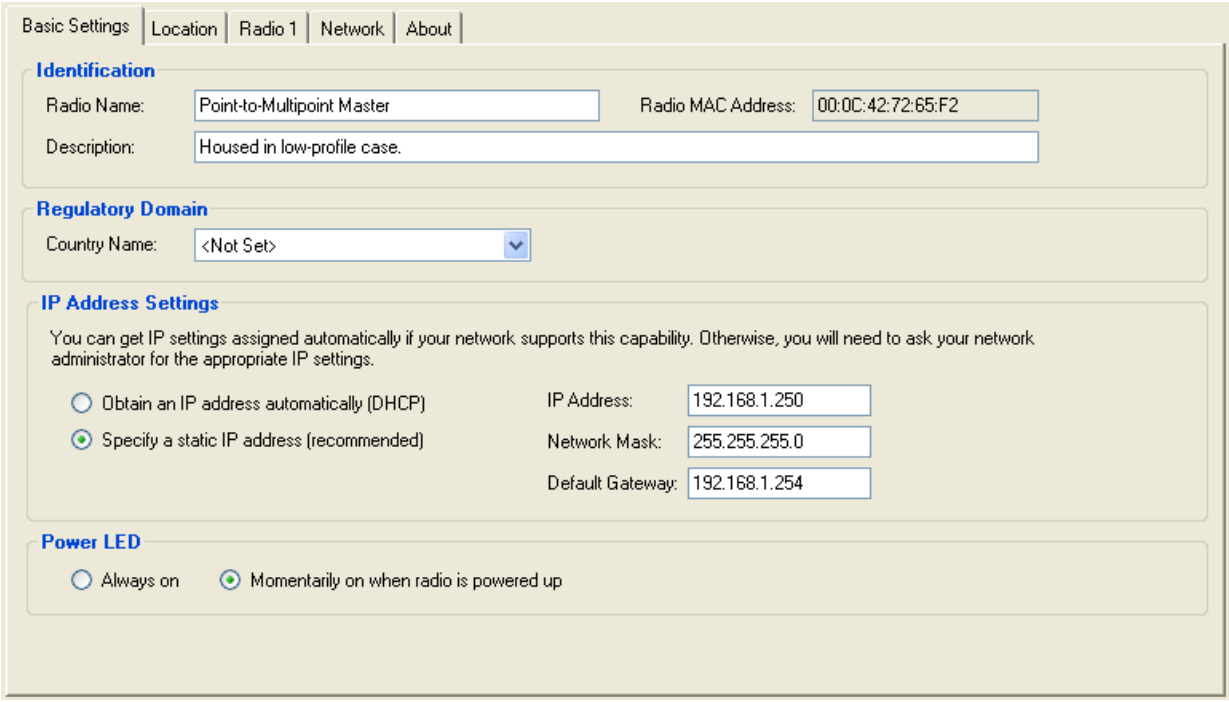
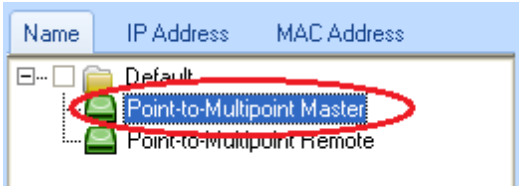
Basic Settings Tab

The following screen shot shows the basic configuration settings tab for a point-to-multipoint radio:



The following tables describe the settings found in each group in the basic settings tab.

Identification	
Field Name	**Description**
Radio Name	Enter a name used to identify the radio (up to a maximum of 64 characters). The name you enter will be displayed in the radio list, and in all other places where a reference to the radio is made. 
Radio MAC Address	Displays the MAC address assigned to the radio. (This is essentially the MAC address of the radio's first Ethernet adapter.)

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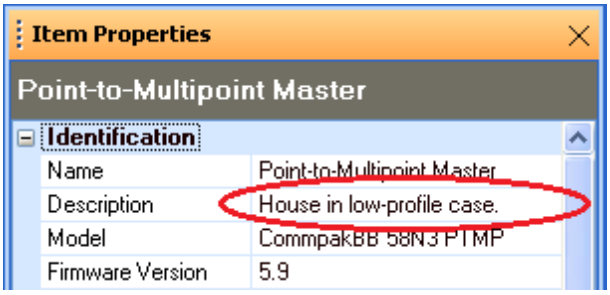
Identification	
Field Name	**Description**
Description	Enter an optional description for the radio. This field allows you to keep track of ad-hoc information associated with the radio, without adding clutter to the radio name. The radio description is displayed in the radio properties panel: 

Regulatory Domain	
Field Name	**Description**
Country Name	Select the country in which the radio is operating. Certain countries have limitations on the radio power output, allowed frequency ranges and frequency bands. Failure to select the appropriate country can result in a radio that is operating outside of the legally allowed ranges. If the radio is operating in the United States or Canada, you can leave this setting to **<Not Set>**.

IP Address Settings	
Field Name	**Description**
Obtain an IP address automatically	Select this option if a DHCP server is available on your radio network, and you want the DHCP server to assign an IP address to the radio.
Specify a static IP address	Select this option to manually assign the radio's IP address. ENCOM recommends this option because it provides for a more secure network (especially if you have not enabled wireless security). **Note:** It is important that each radio in the network is assigned a different IP address. Network performance can suffer greatly if two or more radios are assigned the same IP address.

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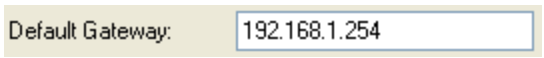
IP Address Settings	
Field Name	**Description**
IP Address	Enter the IP address of the radio. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:
Network Mask	Enter the network mask. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:
Default Gateway	Enter the IP address of the radio or router that allows the radio to connect with devices that are outside of their local LAN or VLAN. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:  Note that the default gateway's IP address must be in the same subnet as the radio's IP address.

Power LED	
Field Name	**Description**
Always On	The external power LED is on as long as the radio is powered. **Note:** This option is visible only if the radio supports an external power indicator LED.
Momentarily on when radio is powered up	The external power LED is on for 1 minute after the radio is powered, and is subsequently turned off. **Note:** This option is visible only if the radio supports an external power indicator LED.

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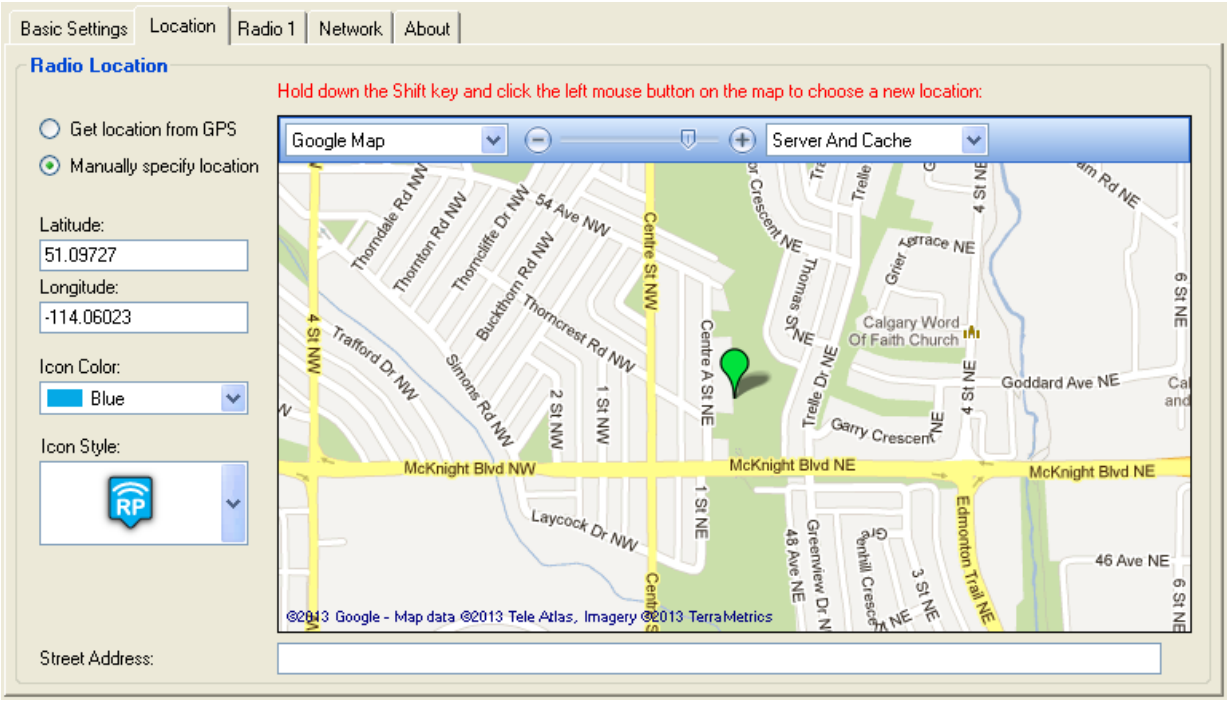
Location Tab

The following screen shot shows the location settings tab for a point-to-multipoint radio:



The following table describes the settings found in the location tab.

Field Name	Description
Get location from GPS	Select this option if you want the radio to get its location from the built-in GPS receiver. This option is not available if the radio does not contain a GPS receiver.
Manually specify location	Select this option if you want to manually specify the location of the radio.
Latitude	Enter the latitude at which the radio is located, in decimal degrees. This value is positive in the northern hemisphere and negative in the southern hemisphere. Alternatively, hold down the Shift key and click the left mouse button on the map to set the radio's position. This process will automatically update the **Latitude** field.
Longitude	Enter the longitude at which the radio is located, in decimal degrees. This value is positive in the eastern hemisphere and negative in the western hemisphere. Alternatively, hold down the Shift key and click the left mouse button on

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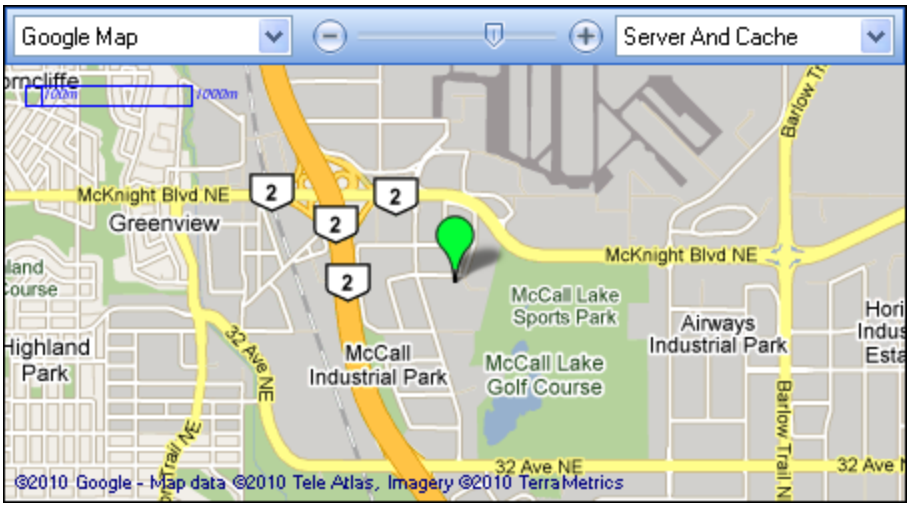
<table>
<tr><td></td><td>the map to set the radio's position. This process will automatically update the Longitude field.</td></tr>
<tr><td>Icon Color</td><td>Select the color of the radio icon. You can use the icon color to visually group radios by radio type, geographical location, VLAN association, etc.</td></tr>
<tr><td>Icon Style</td><td>Select the style of the radio icon. Four icon styles are currently available:
<table>
<tr><th>Icon</th><th>Radio Type</th></tr>
<tr><td> </td><td>Generic radio</td></tr>
<tr><td> </td><td>Master radio</td></tr>
<tr><td> </td><td>Remote radio</td></tr>
<tr><td> </td><td>Repeater radio</td></tr>
<tr><td> </td><td>Dual radio</td></tr>
</table></td></tr>
<tr><td>Embedded map</td><td>The embedded map allows you to see the current location of the radio. A green marker shows the location assigned to the radio.

</td></tr>
</table>

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	To set a new location: • Press and hold down the Shift key on your computer's keyboard. • Click the left mouse button at the location you want to assign to the radio. • The green marker will move to the selected position. **Note:** Refer to the Map Panel topic for more information on the embedded map features.
Street Address	Enter the street address of the radio, if applicable. This information is optional.

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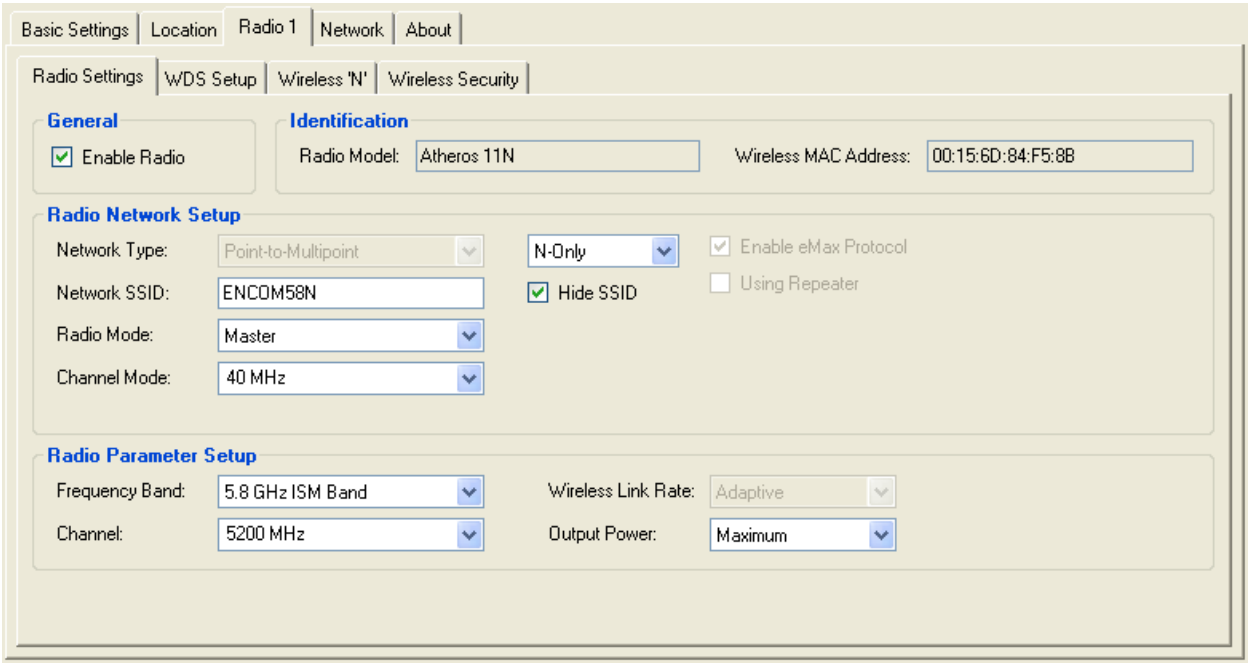
Radio Tab

ENCOM mesh radios contain at least one, and as many as four, wireless radio modules. Each wireless radio module is configured in its own tab. The first radio module is configured in the **Radio 1** tab, the second radio is configured in the **Radio 2** tab, and so on.

The following screen shot shows the radio settings tab for a point-to-multipoint radio:



Because the wireless radio settings are somewhat involved, the radio configuration tab is split up into three sub-tabs. The following topics describe the settings found in each sub-tab:

- Radio Settings sub-tab (N-Cards)
- Radio Settings sub-tab (A-Cards and B/G Cards)
- WDS Setup sub-tab
- Wireless 'N' sub-tab
- Wireless Security sub-tab (N-Mode)
- Wireless Security sub-tab (A-Mode and G-Mode)

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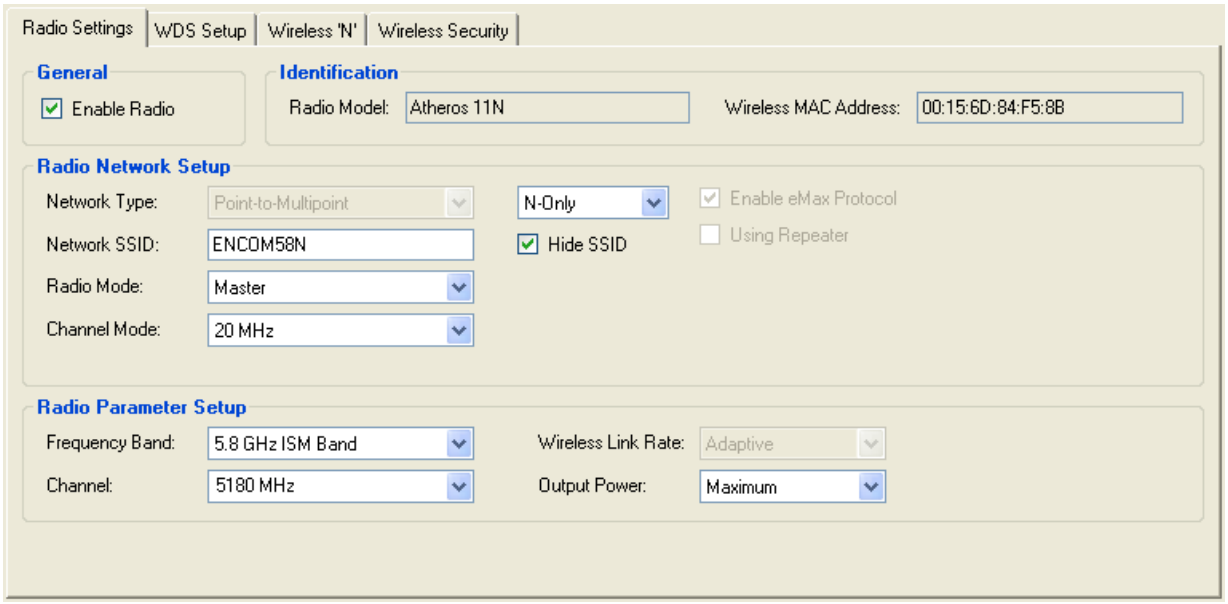
Radio Settings (N Cards)

The following screen shot shows the wireless radio settings tab for a point-to-multipoint radio that is provisioned with a Wireless-'N' card:



The following tables describe the settings found in each group in the wireless radio settings tab.

General	
Field Name	**Description**
Enable Radio	Uncheck this option to disable the wireless radio card. A disabled radio card will not be able to form wireless links with other radios. If you uncheck this option, all of the other options in the *Radio Settings* tab will be disabled.

Identification	
Field Name	**Description**
Radio Model	Displays the model number of the wireless radio card. This information is useful when troubleshooting issues with the radio.
Wireless MAC Address	Displays the MAC address assigned to the wireless radio card. For point-to-multipoint radios, the MAC address of the wireless radio cards are different than the MAC address of the radio's first Ethernet interface.

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<table>
<tr><th colspan="2">Radio Network Setup</th></tr>
<tr><th>Field Name</th><th>Description</th></tr>
<tr><td>Network Type</td><td>Identifies the radio network type. This setting cannot be changed for point-to-multipoint radios.</td></tr>
<tr><td>Wireless Mode</td><td>The drop-down list at the right of the Network Type setting allows you to specify the 802.11 mode under which the wireless radio card will operate, as shown in the following example:

Depending on the type of wireless radio card provisioned in your radio, one of more of the following options will be available:
<table>
<tr><th>Option</th><th>Description</th></tr>
<tr><td>A-Only</td><td>Operate in the standard 802.11a mode in the 5.8 GHz frequency band.
Client devices cannot attach to the radio.</td></tr>
<tr><td>G-Only</td><td>Operate in the standard 802.11g mode in the 2.4 GHz frequency band.
Client devices cannot attach to the radio.</td></tr>
<tr><td>N-Only</td><td>Operate in the 802.11n (Wireless-N) mode in either the 2.4 or 5.8 GHz frequency band.
Client devices cannot attach to the radio.</td></tr>
<tr><td>A/N Clients</td><td>Operate in the standard 802.11a and 802.11n modes in the 5.8 GHz frequency band.
Client devices are able to attach to the radio.</td></tr>
<tr><td>B/G/N Clients</td><td>Operate in the standard 802.11b, 802.11g or 802.11n modes in the 2.4 GHz frequency band.
Client devices are able to attach to the radio.</td></tr>
</table></td></tr>
<tr><td>Network SSID</td><td>Enter a name used to identify the network in which the wireless radio will take part. The Network SSID is case sensitive, and may contain spaces.
Note: You should change the default SSID assigned at the factory to a</td></tr>
</table>

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Radio Network Setup	
	unique SSID for your network. You can minimize interference between adjacent networks by assigning a unique SSID to each network. **Important:** All radios that participate in the same network must be assigned the same Network SSID.
Hide SSID	Check this option to prevent the Network SSID from being broadcast by the wireless radio. This prevents external devices from being able to discover the network's SSID (and potentially connect to it).
Radio Mode	Select the radio mode based on the location of the radio with respect to the network operations center. Note that when operating in Wireless-N mode, the repeater radio mode is not available. Refer to the following topics for more information on radio mode options that are available: • Master Radio Setup • Repeater Radio Setup • Remote Radio Setup
Channel Mode	This option allows you to set the width of the frequency channel you are using. Selecting a smaller frequency for the **Channel Mode** increases the distance over which you can establish a wireless link, at the cost of reduced bandwidth. For most applications 40 MHz is acceptable.
Enable eMax Protocol	Check this option to enable the eMax protocol. The eMax protocol is a proprietary protocol that increases bandwidth and security on the wireless network. **Note:** Due to compatibility issues, the eMax protocol cannot be used if there is a repeater in the network, or if 802.11 clients need to be supported by the radio. **Note:** When operating in N-Only mode, the eMax protocol is always enabled.
Using Repeater	Check this option if there is a repeater in the network. **Note: W**hen operating in N-Only mode, repeaters are not available.
Enable Roaming	Refer to the **Radio Mode** setup topics (see links above) for information on this option.

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Radio Network Setup	
Parent Radio MAC Address	Refer to the **Radio Mode** setup topics (see links above) or information on this option.

Radio Parameter Setup	
Field Name	**Description**
Frequency Band	Displays the nominal frequency at which the radio operates. This option can be changed if the radio card supports more than one band.
Channel	Select the radio's operating frequency. In **Auto-Frequency** mode, a master radio automatically searches for the frequency that has the least activity. It then selects that frequency and uses it to communicate with the repeater or remote radios. For the most stable link, you should select a specific frequency from the list of available frequencies. (You can use the STRATOS Spectrum Scan panel to determine the channel that has the least amount of activity in the vicinity of the radio.) If a repeater is present in the network, both the master and repeater radios must be set to the same specific frequency. Remote radios are always configured to run in **Auto-Frequency** mode. They will automatically adjust their operating frequencies to match the master's.
Wireless Link Rate	Select the rates at which the radio will communicate with the other radios in the network. When operating in A-Mode or G-Mode, the default setting for this option is **Adaptive**. When operating in N-Mode, the link rate is always set to **Adaptive**. The **Adaptive** link rate automatically adjusts the radio's data rate to account for the current network conditions. It typically provides the most reliable network performance. A fixed rate helps reduce data latency, and may be used if the performance of the link is more important than the reliability. If you select a fixed rate, a second drop-down list box is displayed, as shown in the following example: Select the minimum allowed bit rate from the left-hand list, and the maximum allowed rate from the right-hand list.

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	Regardless of the range you specify, the 6 Mbps rate will always be included in the list of allowable rates. This allows the radio to fall back to the lowest bit rate if it is not able to maintain the higher bit rates.
Output Power	Select the wireless radio's output power. Unless constrained by the Regulatory Domain that the radio is operating in, you should use the *Maximum* power setting when the radio is deployed in the field. If the radio is being provisioned or tested in a bench environment, you should use the *Low* power setting.

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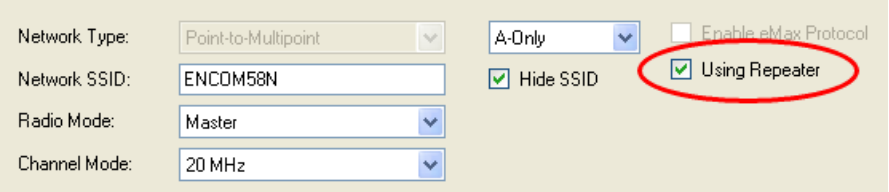
Master Radio Setup (N Cards)

Select the **Master** option for the radio that is located closest to the network operations center. This radio is usually connected to the network via the Ethernet port.

The master radio controls the flow of data in the network and serves as the network's synchronization source. Each broadband network has only one master radio. All the other radios must be configured as either remote or repeater radios.

If the network contains a repeater radio, check the **Using Repeater** option (note that this option is only available when the eMax Protocol is disabled, and only when running in A-Mode or G-Mode).



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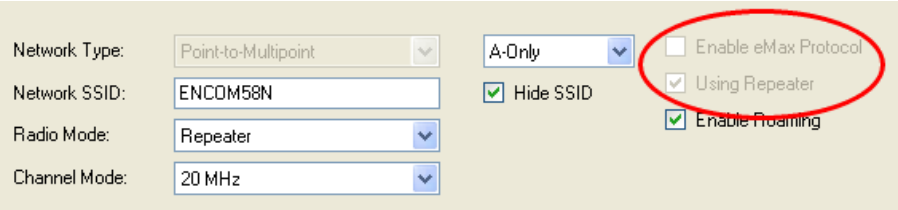
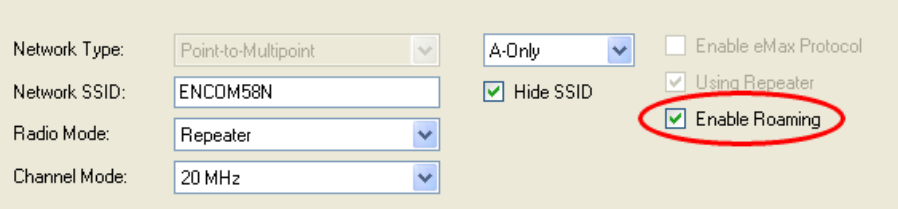
Repeater Radio Setup (N Cards)

Select the **Repeater** option for a radio that provides a link between the master and remote radios. Note that a repeater is only available when running in A-Mode or G-Mode.

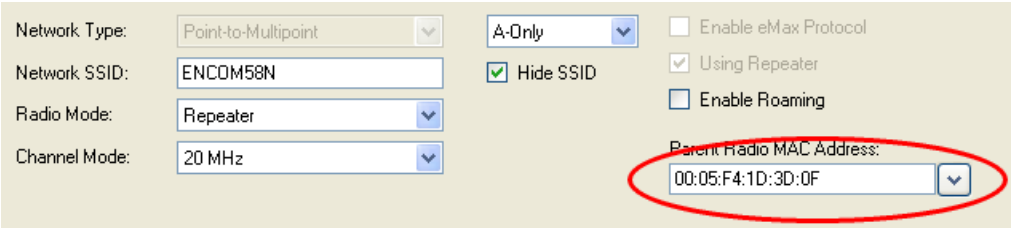
When this option is selected, the **Using Repeater** option is automatically checked, and the **Enable eMax Protocol** option is unchecked (the eMax protocol cannot be used when there is a repeater in the network).



By default, the **Enable Roaming** option is checked. This causes the repeater radio to automatically detect and communicate with the master radio.



If you encounter connectivity issues between the repeater and the master radio, you may want to manually select the master radio to which the remote will connect. To do this, uncheck the **Enable Roaming** option. The **Parent Radio MAC Address** option will be displayed.



Enter the MAC address of the master radio in the **Parent Radio MAC Address** option.

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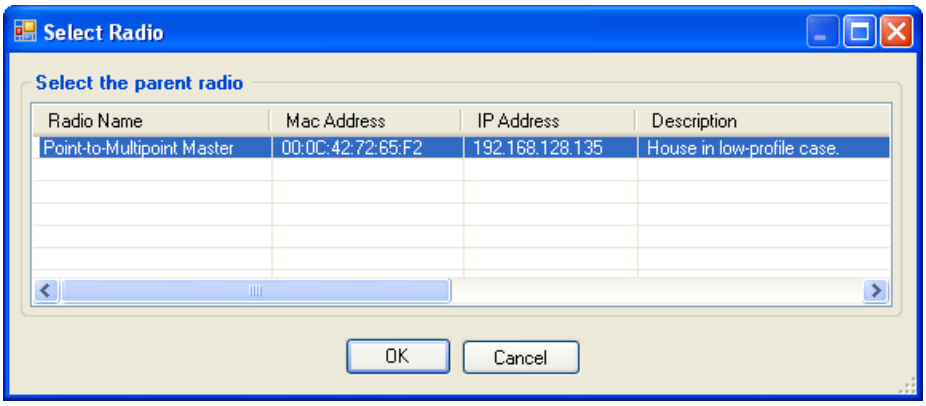
Alternatively, click on the button at the right of the MAC address field. The *Select Radio* form will be displayed. This form lets you choose the master from the list of radios that are currently connected to the repeater.



NOTE Note that installing a repeater will reduce the network throughput by half. It should only be used when there is no other option available, or if the reduction in performance is not important.

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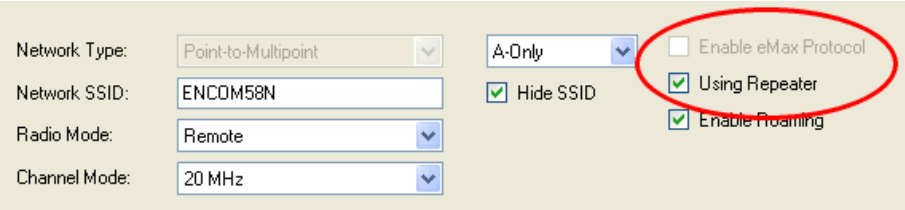
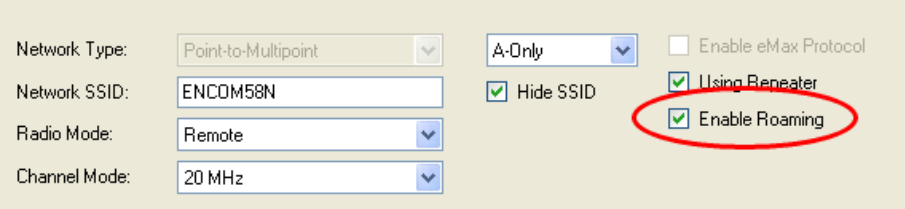
Remote Radio Setup (N Cards)

Select the **Remote** option for a radio that is as the far end of the point-to-multipoint network.

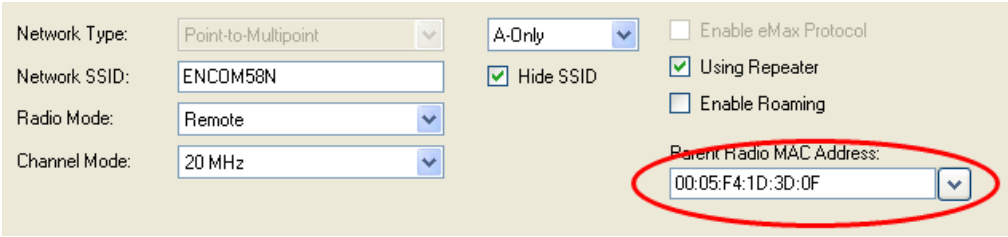
If the network contains a repeater, check the **Using Repeater** option (note that this option is only available when the eMax Protocol is disabled, and only when running in A-Mode or G-Mode).



By default, the **Enable Roaming** option is checked. This causes the remote radio to automatically detect and communicate with the master radio.



If you encounter connectivity issues between the remote radio and the master, you may want to manually select the radio to which the remote will connect. To do this, uncheck the **Enable Roaming** option. The **Parent Radio MAC Address** option will be displayed.



Enter the MAC address of the master or repeater to which the remote will connect in the **Parent Radio MAC Address** option.

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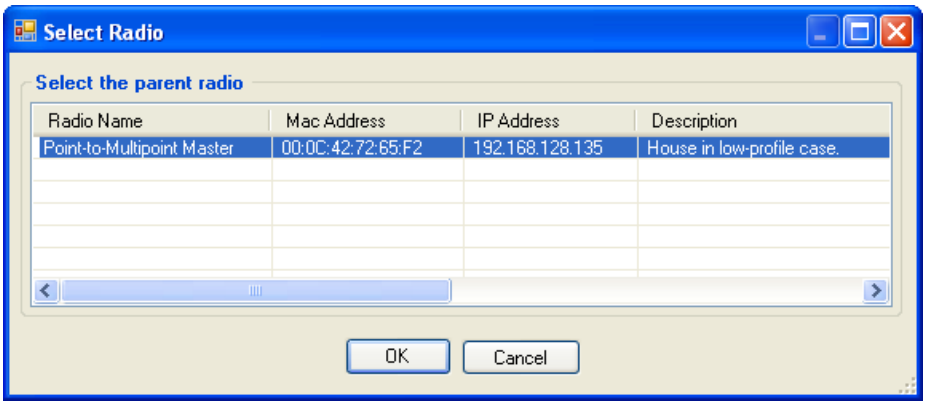
Alternatively, click on the button at the right of the MAC address field. The *Select Radio* form will be displayed. This form lets you choose the parent from the list of radios that are connected to the current radio.



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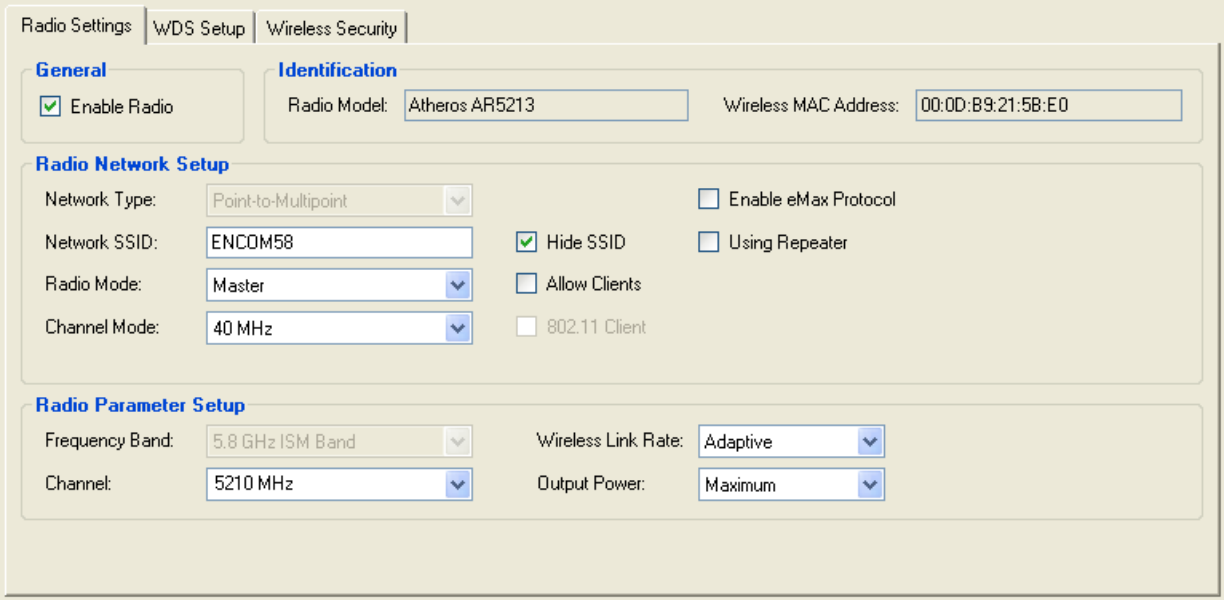
Radio Settings (A and B/G Cards)

The following screen shot shows the wireless radio settings tab for a point-to-multipoint radio that is provisioned with an A (5.8 GHz) or B/G (2.4 GHz) card:



The following tables describe the settings found in each group in the wireless radio settings tab.

General	
Field Name	**Description**
Enable Radio	Uncheck this option to disable the wireless radio card. A disabled radio card will not be able to form wireless links with other radios. If you uncheck this option, all of the other options in the *Radio Settings* tab will be disabled.

Identification	
Field Name	**Description**
Radio Model	Displays the model number of the wireless radio card. This information is useful when troubleshooting issues with the radio.
Wireless MAC Address	Displays the MAC address assigned to the wireless radio card. For point-to-multipoint radios, the MAC address of the wireless radio cards are different than the MAC address of the radio's first Ethernet interface.

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Radio Network Setup	
Field Name	**Description**
Network Type	Identifies the radio network type. This setting cannot be changed for point-to-multipoint radios.
Network SSID	Enter a name used to identify the network in which the wireless radio will take part. The Network SSID is case sensitive, and may contain spaces. **Note:** You should change the default SSID assigned at the factory to a unique SSID for your network. You can minimize interference between adjacent networks by assigning a unique SSID to each network. **Important:** All radios that participate in the same network must be assigned the same Network SSID.
Hide SSID	Check this option to prevent the Network SSID from being broadcast by the wireless radio. This prevents external devices from being able to discover the network's SSID (and potentially connect to it).
Radio Mode	Select the radio mode based on the location of the radio with respect to the network operations center. Refer to the following topics for more information on radio mode options that are available: • Master Radio Setup • Repeater Radio Setup • Remote Radio Setup
Allow Clients	Check this option to allow external 802.11 compliant devices, such as laptops, WiFi cameras, etc. to connect to the radio. **Note:** This option is not compatible with the eMax protocol. If checked, the eMax protocol is automatically disabled. **Note:** Since most 802.11 compliant devices only support 20 MHz channels, you should set the **Channel Mode** option to 20 MHz when you select this option. **Note:** This option is only available for Master and Repeater radios. Remote radios do not support client devices.

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Radio Network Setup	
Field Name	**Description**
Channel Mode	This option allows you to set the width of the frequency channel you are using. Selecting a smaller frequency for the **Channel Mode** increases the distance over which you can establish a wireless link, at the cost of reduced bandwidth. For most applications, a 40 MHz channel mode is acceptable. **Note:** If you check the **Allow Clients** option to support 802.11 compliant devices, you should choose the 20 MHz channel mode.
802.11 Client	Check this option if the radio needs to connect to a non-Encom WiFi network.
Enable eMax Protocol	Check this option to enable the eMax protocol. The eMax protocol is a proprietary protocol that increases bandwidth and security on the wireless network. **Note:** Due to compatibility issues, the eMax protocol cannot be used if there is a repeater in the network, or if 802.11 clients need to be supported by the radio.
Using Repeater	Check this option if there is a repeater in the network.
Enable Roaming	Refer to the **Radio Mode** topics (see links above) for information on this option.
Parent Radio MAC Address	Refer to the **Radio Mode** topics (see links above) or information on this option.

Radio Parameter Setup	
Field Name	**Description**
Frequency Band	Displays the nominal frequency at which the radio operates. This option can be changed if the radio card supports more than one band.
Channel	Select the radio's operating frequency. In **Auto-Frequency** mode, a master radio automatically searches for the frequency that has the least activity. It then selects that frequency and uses it to communicate with the repeater or remote radios. For the most stable link, you should select a specific frequency from the list of available frequencies. (You can use the STRATOS Spectrum Scan

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Radio Parameter Setup	
Field Name	**Description**
	panel to determine the channel that has the least amount of activity in the vicinity of the radio.) If a repeater is present in the network, both the master and repeater radios must be set to the same specific frequency. Remote radios are always configured to run in **Auto-Frequency** mode. They will automatically adjust their operating frequencies to match the master's.
Wireless Link Rate	Select the rates at which the radio will communicate with the other radios in the network. The default setting for this option is **Adaptive**. The **Adaptive** link rate automatically adjusts the radio's data rate to account for the current network conditions. It typically provides the most reliable network performance. A fixed rate helps reduce data latency, and may be used if the performance of the link is more important than the reliability. If you select a fixed rate, a second drop-down list box is displayed, as shown in the following example: Select the minimum allowed bit rate from the left-hand list, and the maximum allowed rate from the right-hand list. Regardless of the range you specify, the 6 Mbps rate will always be included in the list of allowable rates. This allows the radio to fall back to the lowest bit rate if it is not able to maintain the higher bit rates.
Output Power	Select the wireless radio's output power. Unless constrained by the Regulatory Domain that the radio is operating in, you should use the *Maximum* power setting when the radio is deployed in the field. If the radio is being provisioned or tested in a bench environment, you should use the *Low* power setting.

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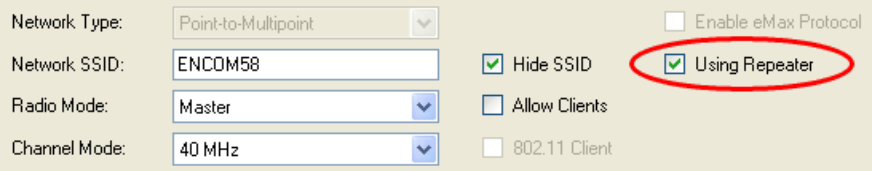
Master Radio Setup (A and B/G Cards)

Select the **Master** option for the radio that is located closest to the network operations center. This radio is usually connected to the network via the Ethernet port.

The master radio controls the flow of data in the network and serves as the network's synchronization source. Each point-to-multipoint network has only one master radio. All the other radios must be configured as either remote or repeater radios.

If the network contains a repeater radio, check the **Using Repeater** option (note that this option is only available when the eMax Protocol is disabled).



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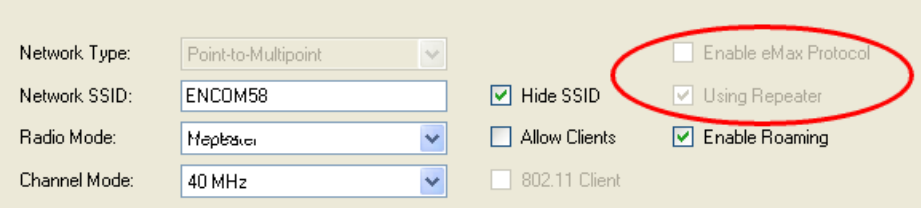
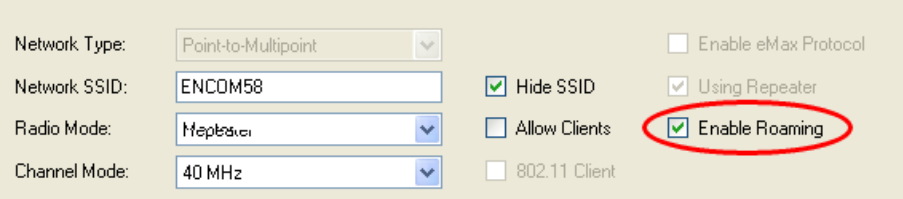
Repeater Radio Setup (A and B/G Cards)

Select the **Repeater** option for a radio that provides a link between the master and remote radios.

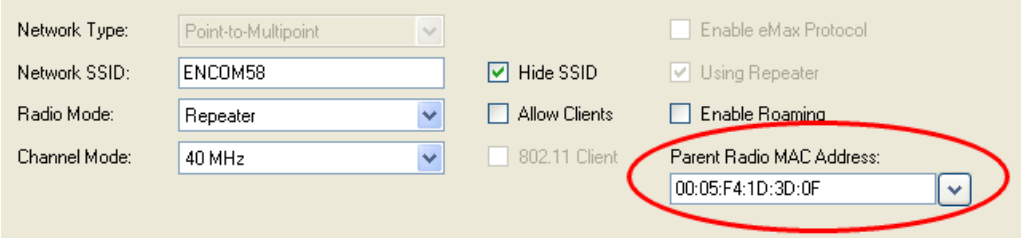
When this option is selected, the **Using Repeater** option is automatically checked, and the **Enable eMax Protocol** option is unchecked (the eMax protocol cannot be used when there is a repeater in the network).



By default, the **Enable Roaming** option is checked. This causes the repeater radio to automatically detect and communicate with the master radio.



If you encounter connectivity issues between the repeater and the master radio, you may want to manually select the master radio to which the remote will connect. To do this, uncheck the **Enable Roaming** option. The **Parent Radio MAC Address** option will be displayed.



Enter the MAC address of the master radio in the **Parent Radio MAC Address** option.

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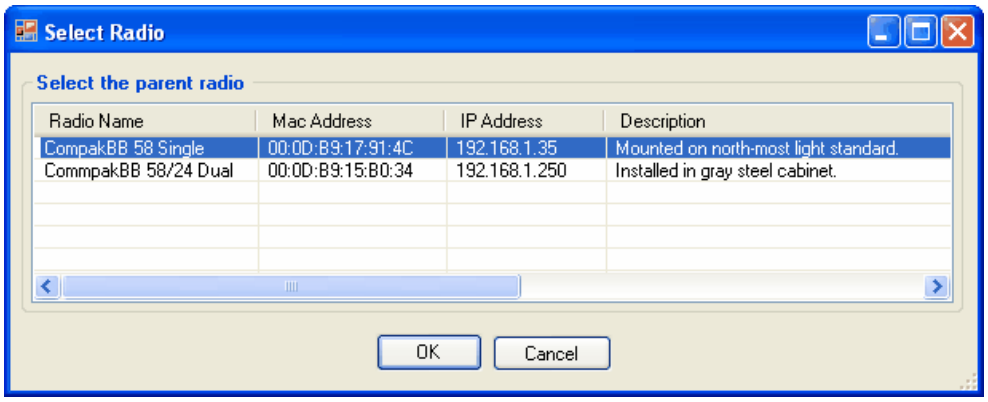
Alternatively, click on the button at the right of the MAC address field. The *Select Radio* form will be displayed. This form lets you choose the master from the list of radios that are currently connected to the repeater.



NOTE Note that installing a repeater will reduce the network throughput by half. It should only be used when there is no other option available, or if the reduction in performance is not important.

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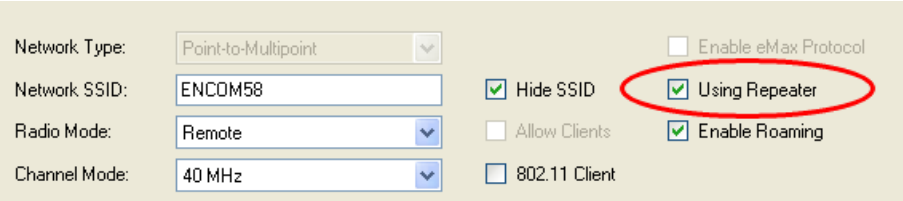
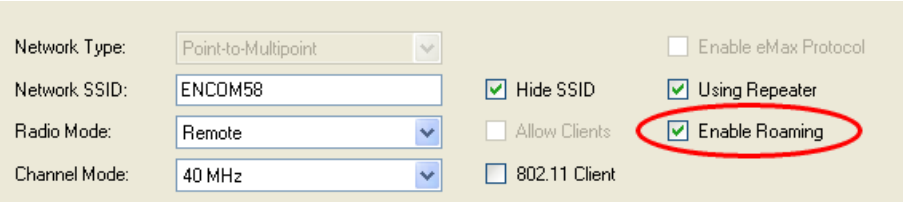
Remote Radio Setup (A and B/G Cards)

Select the **Remote** option for a radio that is as the end of the point-to-multipoint network.

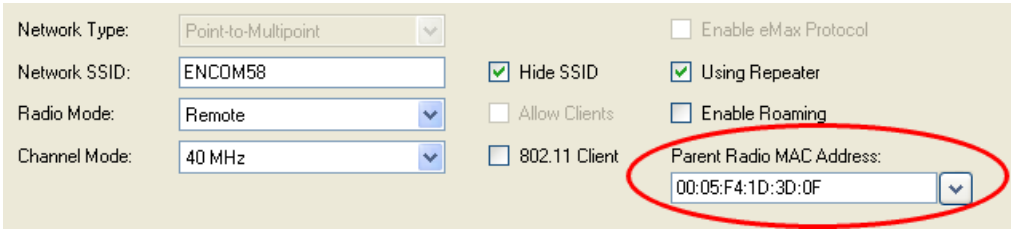
If the network contains a repeater, check the **Using Repeater** option (note that this option is only available when the eMax Protocol is disabled).



By default, the **Enable Roaming** option is checked. This causes the remote radio to automatically detect and communicate with the master or repeater.



If you encounter connectivity issues between the remote radio and the master or repeater, you may want to manually select the radio to which the remote will connect. To do this, uncheck the **Enable Roaming** option. The **Parent Radio MAC Address** option will be displayed.



Enter the MAC address of the master or repeater to which the remote will connect in the **Parent Radio MAC Address** option.

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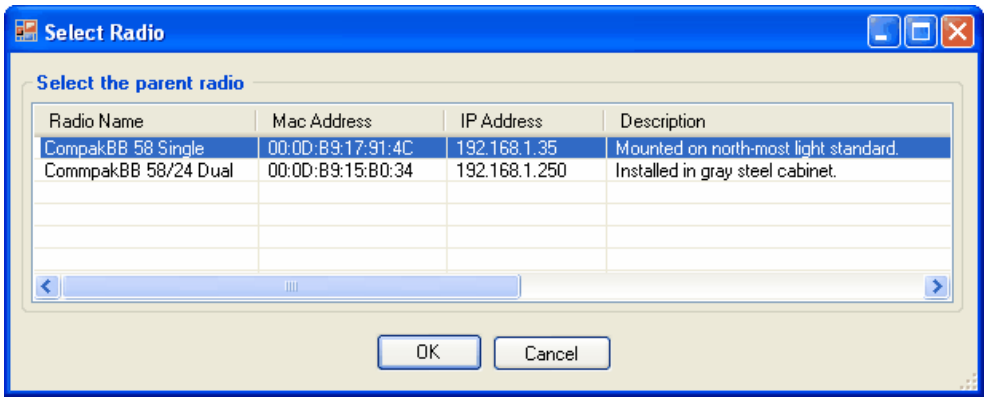
Alternatively, click on the button at the right of the MAC address field. The *Select Radio* form will be displayed. This form lets you choose the parent from the list of radios that are connected to the current radio.



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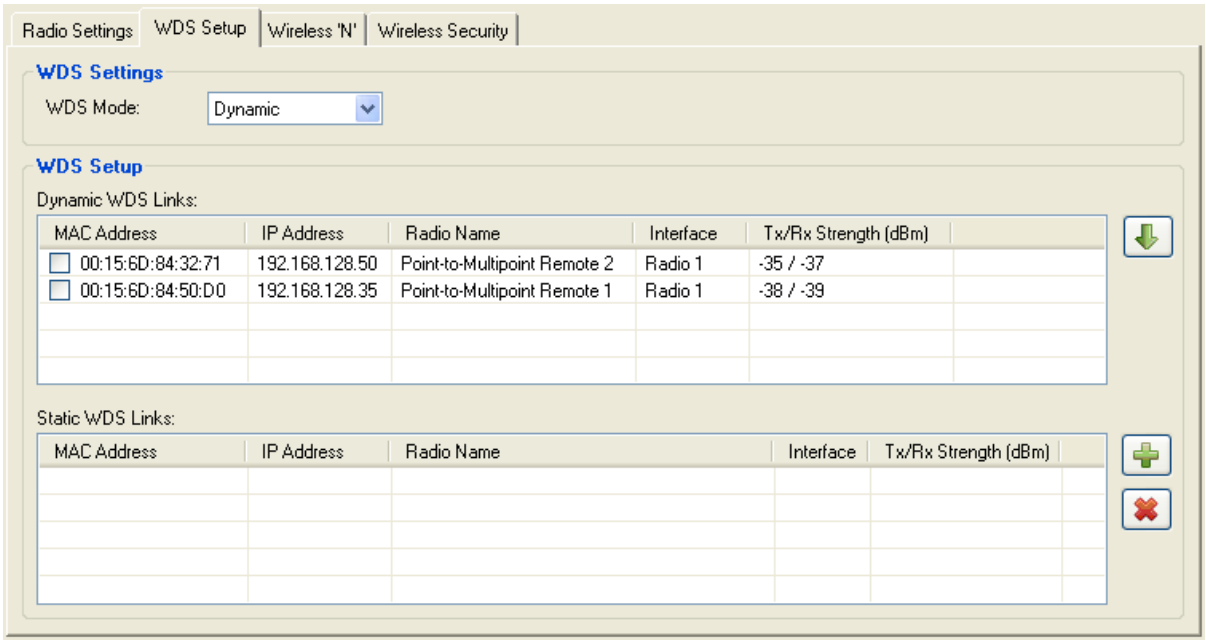
WDS Setup

The following screen shot shows the *WDS Setup* tab for a point-to-multipoint radio:



The settings on this tab are used to specify the WDS (Wireless Distribution System) connections that are allowed to form with other radios in the network.

The following tables describe the settings found in each group in the *WDS Setup* tab.

WDS Settings	
Field Name	**Description**
WDS Mode	Select the method used to determine if an external radio is allowed to form a wireless connection with the radio being configured. One of the following options can be used: **WDS Mode** / **Description** Dynamic: All connections from other radios will be accepted. This is the default, and recommended, setting. Static: Only those connections listed in the **Static WDS Links** table will be allowed to form. Disabled: No connections from other radios will be accepted. This defeats the purpose of a wireless network, and is not recommended.

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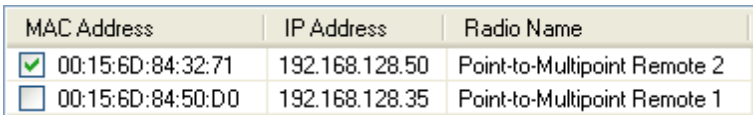
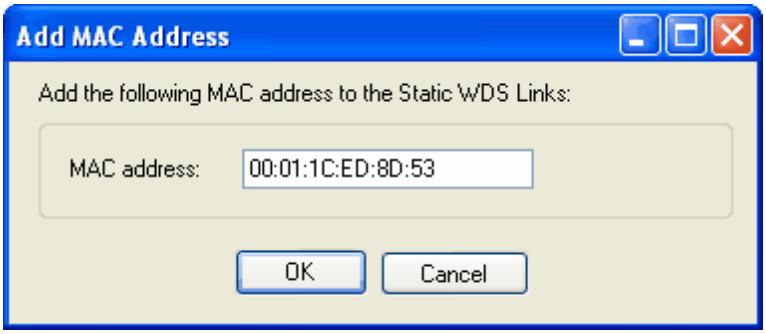
WDS Setup	
Field Name	**Description**
Dynamic WDS Links	This list contains the list of WDS links that are currently active.
 (Move button)	Click on the **Move** button to convert dynamic WDS links to static links. The links will be transferred from the **Dynamic WDS Links** list to the **Static WDS Links** list. To convert dynamic WDS links to static WDS links: 1. Select one or more links in the **Dynamic WDS Links** table. To select a link, check the associated check box. In the following example, the first WDS link is selected.  2. Click on the **Move** button to convert the selected dynamic links to static links.
Static WDS Links	This list contains the list of WDS links that are allowed to form.
 (Add button)	Click on the **Add** button to manually add the MAC address of a remote radio to the static WDS list. When selected, the following form is displayed:  Specify the MAC address of the radio you want to allow, and press the **OK** button. The new MAC address will be added to the **Static WDS Links** list. **Note:** If you add the MAC address of a radio that is not known to ENCOM STRATOS, only the MAC address will be displayed in the disallowed list. If the radio is known to STRATOS, the associated IP Address and radio name will be included. Both scenarios are shown in the following example:

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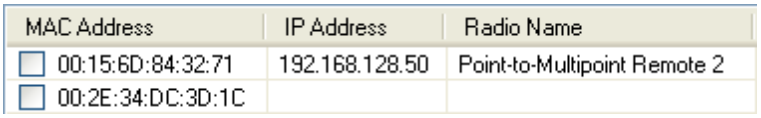
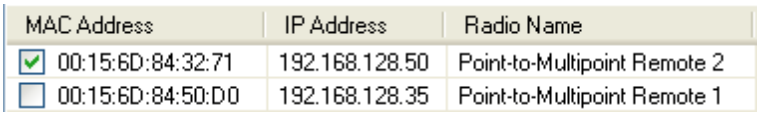
WDS Setup	
Field Name	**Description**
	
 (Remove button)	Click on the **Remove** button to remove links from the static WDS list. To remove static WDS links: 1. Select one or more links in the **Static WDS Links** table. To select a link, check the associated check box. In the following example, the first WDS link is selected.  2. Click on the **Remove** button to remove the selected static links.

The following table describes the information that is displayed in the Dynamic and Static WDS Link tables:

Column	Description
MAC Address	The MAC address of the remote radio.
IP Address	The IP address of the remote radio.
Radio Name	The name assigned to the remote radio.
Interface	Identifies the wireless radio module on the remote radio. The first radio module is **Radio 1**, the second radio module is **Radio 2**, etc.
Tx/Rx Strength	The transmit and receive signal strengths, in dBm, of the wireless connection between this radio and the remote radio.

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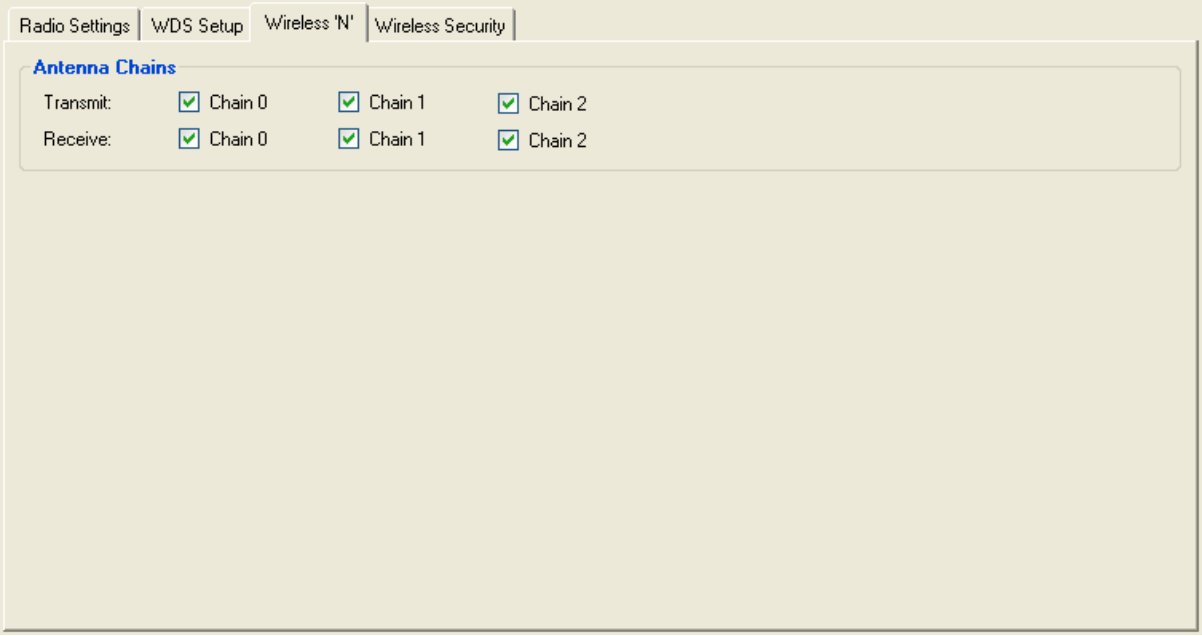
Wireless 'N' Settings

Note that the Wireless 'N' settings tab is only displayed if the associated radio card supports Wireless N operation.

The following screen shot shows the wireless 'N' settings tab for a point-to-multipoint radio:



ENCOM offers Wireless-N radio cards that support up to 3 antennas. STRATOS will automatically display the number of antennas that are supported by your radio in the *Antenna Chains* group.

The following table describes the settings found in each group in the wireless 'N' settings tab.

Antenna Chains	
Field Name	**Description**
Transmit	Specify the antennas to use for transmitting data. Check the **Chain** option to enable the associated antenna, and uncheck it to disable the antenna. For optimal performance, you should enable all of the antennas supported by your radio card.
Receive	Specify the antennas to use for receiving data. Check the **Chain** option to enable the associated antenna, and uncheck it to disable the antenna. For optimal performance, you should enable all of the antennas supported by your radio card.

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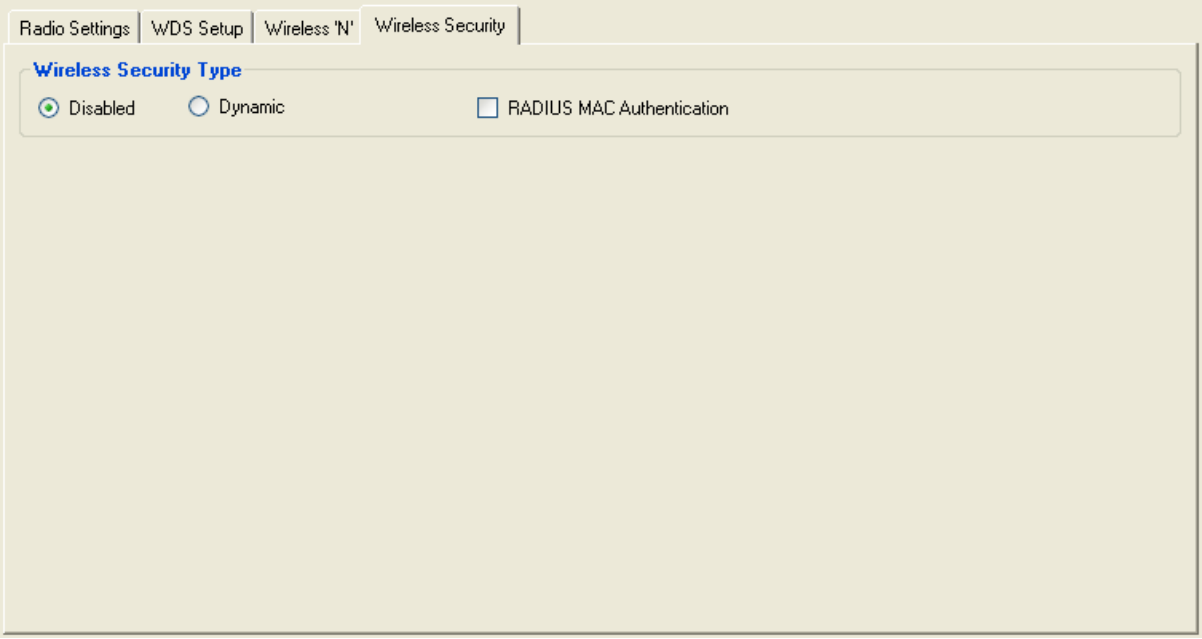
Wireless Security Settings (N Mode)

The following screen shot shows the wireless security settings tab for a point-to-multipoint radio, when the **Wireless Mode** option in the Radio Settings tab is set to 'N-Mode':



The *Wireless Security Types* group allows you to specify the security protocols used to protect the wireless communication links. You can choose from the following options:

Wireless Security Types	
Option	**Description**
Disabled	Select this option if you do not want to enable security. This option is not recommended since it allows anyone that has knowledge of the network's SSID to connect to the network.
Dynamic	This option enables wireless encryption that uses dynamically allocated keys. This option provides the most secure communication link.
RADIUS MAC Authentication	Check this option if you use a RADIUS server for authentication. A Remote Authentication Dial in User Service (RADIUS) server acts as a centralized access and authorization point for network service. The authentication service is then handled by the RADIUS server instead of the ENCOM radios.

Important: The security settings must be the identical for all radios on the network. Radios that have different security settings will not be able to communicate with each other.

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Note: Encom Wireless Data Solutions highly recommends that you confer with your I.T. department to determine the appropriate level of security for your network.

The Dynamic security option contains additional settings that need to be configured. The following topic describes these in more detail:

- Dynamic Security Options

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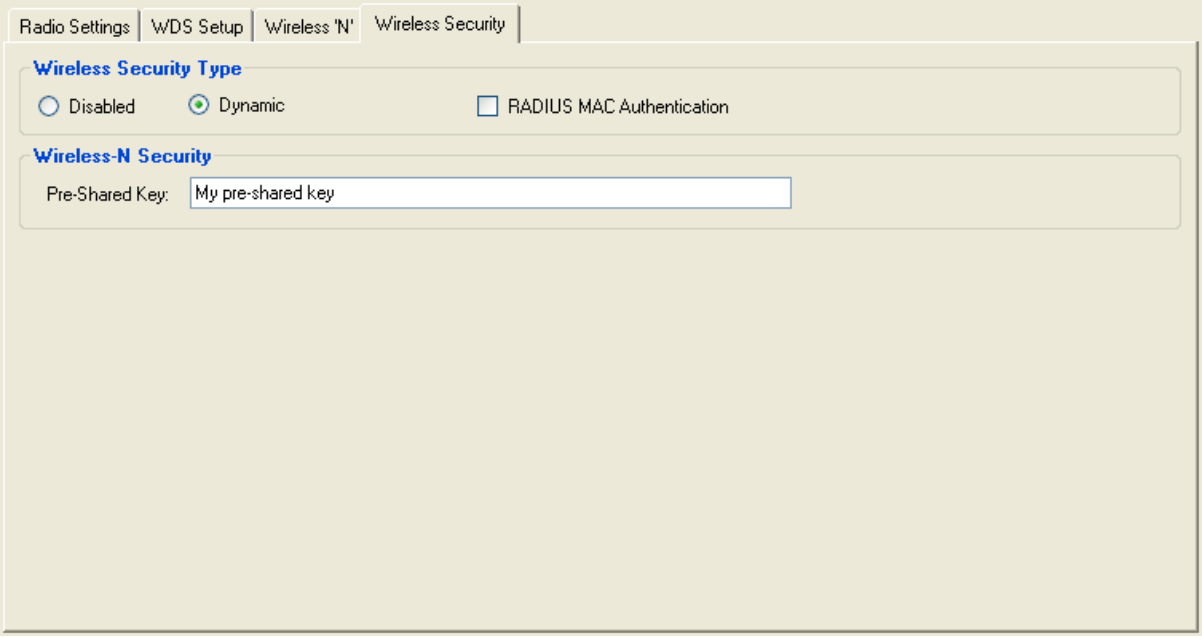
Dynamic Security Settings (N Mode)

The following screen shot shows the dynamic security options for a point-to-multipoint radio, when the **Wireless Mode** option in the Radio Settings tab is set to 'N-Mode':



The following table describes the dynamic security options found in the *Wireless Security Settings* tab:

Wireless-N Security Types	
Field Name	**Description**
Pre-Shared Key	Enter a pre-shared key used for the authentication process.

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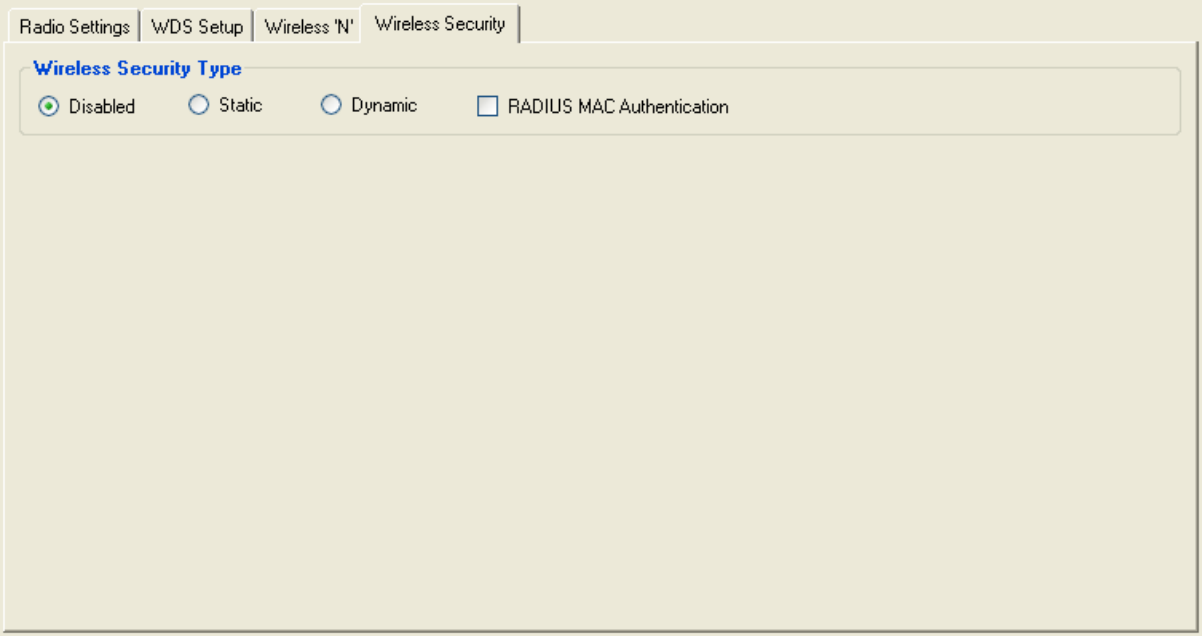
Wireless Security Settings (A and B/G Modes)

The following screen shot shows the wireless security settings tab for a point-to-multipoint radio, when the **Wireless Mode** option in the Radio Settings tab is set to 'A-Mode' or 'G-Mode':



The *Wireless Security Type* group allows you to specify the security protocols used to protect the wireless communication links. You can choose from the following options:

Wireless Security Types	
Option	**Description**
Disabled	Select this option if you do not want to enable security. This option is not recommended since it allows anyone that has knowledge of the Network's SSID to connect to the network.
Static	This option enables wireless encryption that uses static keys. This is an older technology that is not as secure as the Dynamic option. It can, however, provide for a more stable network.
Dynamic	This option enables wireless encryption that uses dynamically allocated keys. This option provides the most secure communication link.
RADIUS MAC Authentication	Check this option if you use a RADIUS server for authentication. A Remote Authentication Dial in User Service (RADIUS) server acts as a centralized access and authorization point for network service. The authentication service is then handled by the RADIUS server instead of

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	the ENCOM radios.

Important: The security settings must be the identical for all radios on the network. Radios that have different security settings will not be able to communicate with each other.

Note: Encom Wireless Data Solutions highly recommends that you confer with your I.T. department to determine the appropriate level of security for your network.

The Static and Dynamic security options contain additional settings that need to be configured. The following topics describe these in more detail:

- Static Security Options
- Dynamic Security Options

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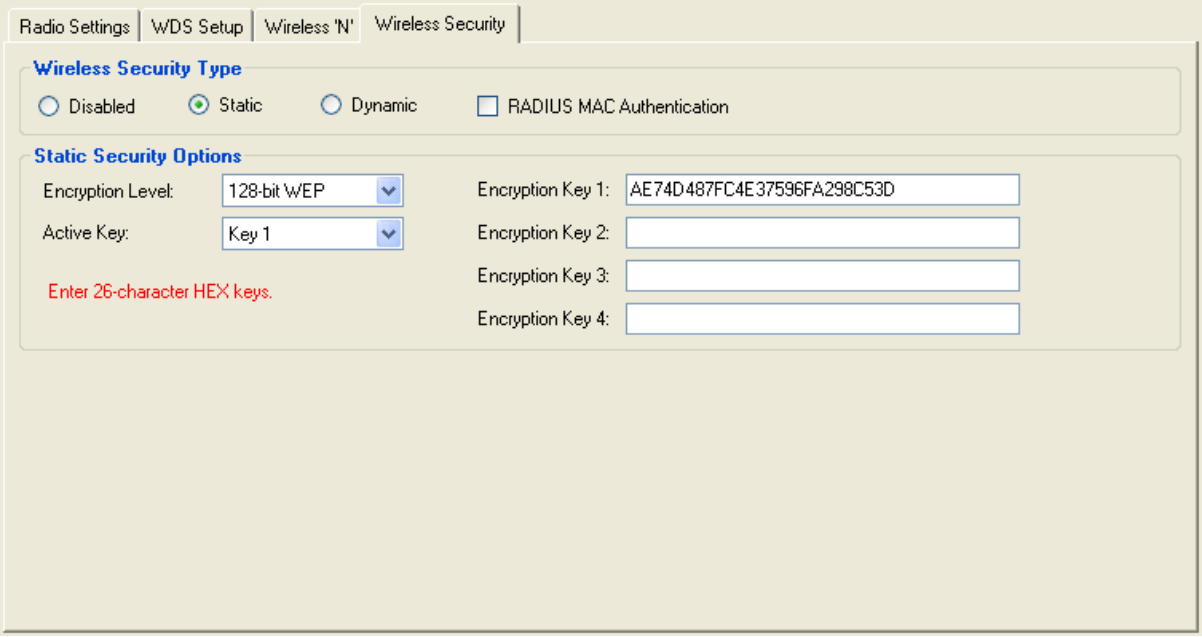
Static Security Settings (A and B/G Modes)

The following screen shot shows the static security options for a point-to-multipoint radio, when the **Wireless Mode** option in the Radio Settings tab is set to 'A-Mode' or 'G-Mode':



The following table describes the static security options found in the *Wireless Security Settings* tab:

Static Security Options	
Field Name	**Description**
Encryption Level	Select the encryption level to use. Three options are available:

Option	Description
64-bit WEP	Uses a 40-bit encryption key coupled with a 24-bit initialization vector. This option is considered to be obsolete, and should only be used for compatibility with existing infrastructure.
128-bit WEP	Uses a 104-bit encryption key coupled with a 24-bit initialization vector. This option is more secure than 64-bit WEP, but still suffers from deficiencies in the WEP algorithm. It should only be used for compatibility with existing infrastructure.
128-bit AES	Uses the 128-bit AES block encryption algorithm couple with the CBC-MAC block chaining technique for added security. This is the most secure of the

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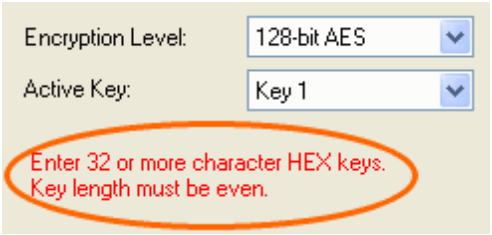
	three static security options.
Active Key	Select the encryption key to use. Although you can define up to four static encryption keys, only one key can be active.
Encryption Key (1-4)	Enter the hexadecimal character sequence to use for the encryption key. Hexadecimal characters include the decimal digits (0-9) and the letters A-F. The number of characters you need to enter depends on the **Encryption Level** you have specified. An indicator, located below the **Active Key** list, will indicate the number of characters you have to enter: 

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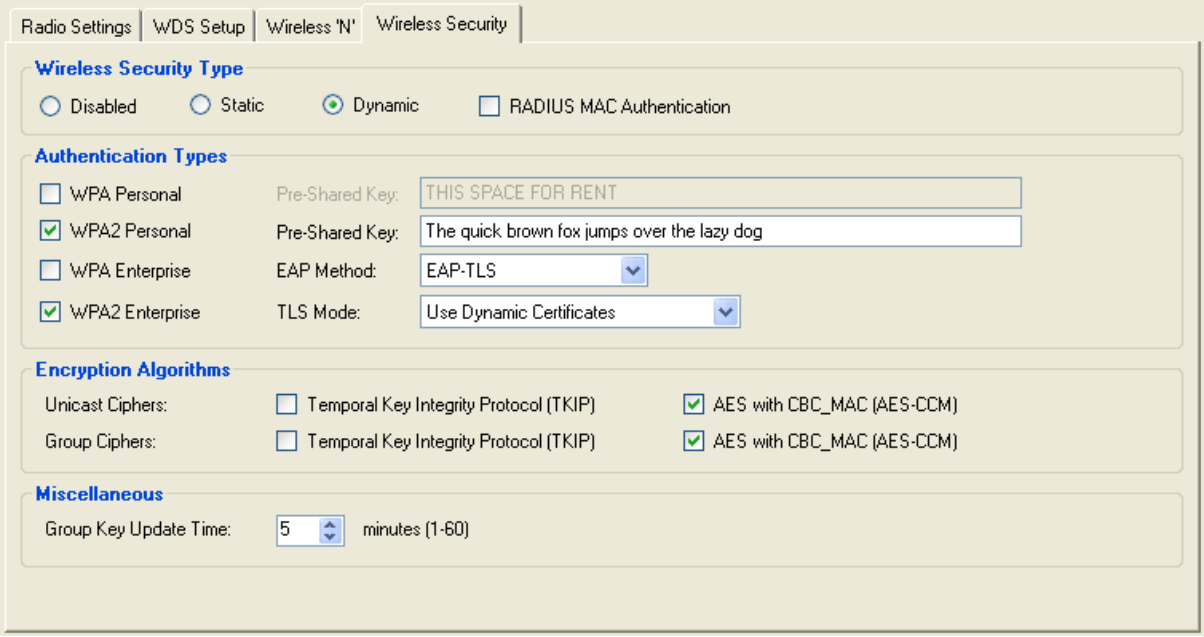
Dynamic Security Settings A and B/G Modes)

The following screen shot shows the DYNAMIC security options for a point-to-multipoint radio, when the **Wireless Mode** option in the Radio Settings tab is set to 'A-Mode' or 'G-Mode':



The following tables describe the dynamic security options found in the *Wireless Security Settings* tab:

Authentication Types	
Field Name	**Description**
WPA Personal	Check this option to enable WPA personal authentication. You must also enter a pre-shared key used for the authentication process.
WPA2 Personal	Check this option to enable WPA2 personal authentication. You must also enter a pre-shared key used for the authentication process.
WPA Enterprise	Check this option to enable WPA enterprise authentication. This option does not require a pre-shared key.
WPA2 Enterprise	Check this option to enable WPA2 enterprise authentication. This option does not require a pre-shared key.

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Authentication Types	
Field Name	**Description**
EAP Method	Specify the authentication protocol to use. Two options are available: **Option** / **Description** Pass Through — Authentication requests are relayed to a RADIUS server. EAP-TLS — TLS certificates are used for authentication. This option is only used by the WPA Enterprise and WPA2 Enterprise authentication types. It is hidden if no enterprise option is selected.
TLS Mode	Specify how TLS certificates are to be used. Two options are available: **Option** / **Description** Use Dynamic Certificates — TLS certificates are negotiated dynamically using anonymous Diffie-Hellman MODP 2048 bit algorithm. Use Imported Certificates — A TLS certificate that has been imported into the radio is used. This option is only used when the **EAP Method** is set to EAP-TLS. It is hidden if the EAP-TLS option is not selected.

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Encryption Algorithms

Field Name	Description
Unicast Ciphers	Check the ciphers that can be used to encrypt frames sent to individual radios. Two options are available. **Option** / **Description** TKIP: Temporal Key Integrity Protocol. An encryption protocol that is compatible with legacy WEP equipment, but enhanced to correct some WEP flaws. This option should only be used for networks that contain legacy WEP devices. AES-CCM: A more secure WPA encryption protocol, based on the reliable AES (Advanced Encryption Standard). Use this option is preferred if the there are no legacy WEP devices in the network.
Group Ciphers	Check the ciphers that can be used to encrypt frames broadcast to all radios. Two options are available. **Option** / **Description** TKIP: Temporal Key Integrity Protocol. An encryption protocol that is compatible with legacy WEP equipment, but enhanced to correct some WEP flaws. This option should only be used for networks that contain legacy WEP devices. AES-CCM: A more secure WPA encryption protocol, based on the reliable AES (Advanced Encryption Standard). Use this option is preferred if the there are no legacy WEP devices in the network.

Miscellaneous

Field Name	Description
Group Key Update Time	The interval at which the dynamically generated keys are updated.

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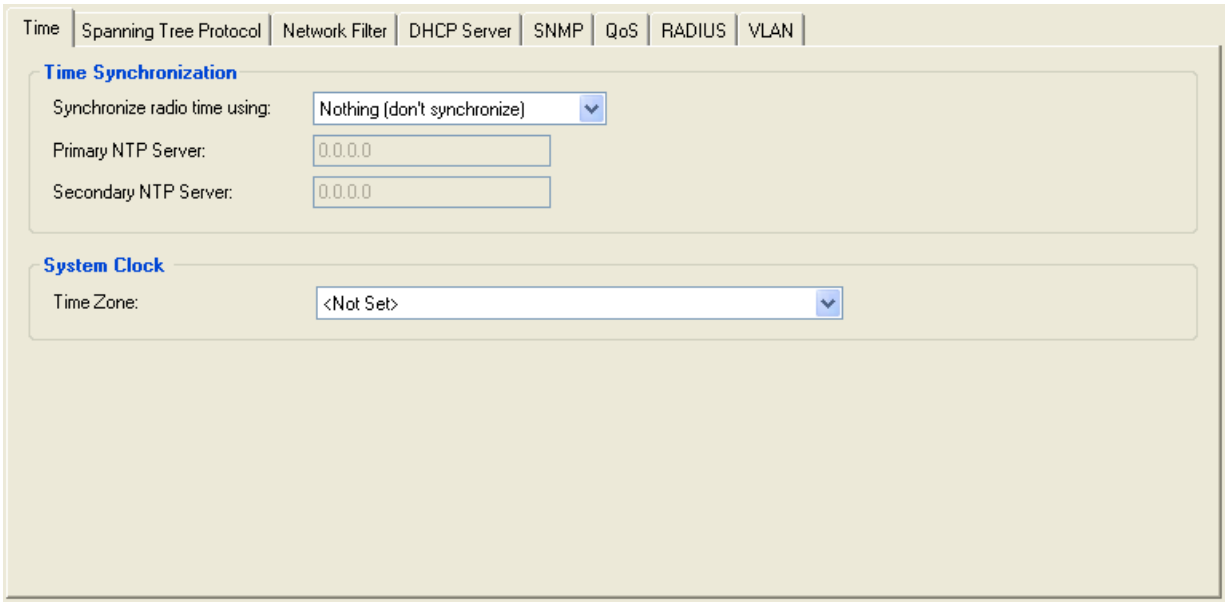
Network Tab

The following screen shot shows the network settings tab for a point-to-multipoint radio:



Because a large number of configuration options are available, the network configuration tab is split up into a number of sub-tabs. The following topics describe the settings found in each sub-tab:

- Time Settings
- Spanning Tree Protocol Settings
- Network Filter Settings
- DHCP Server Settings
- SNMP Settings
- QoS (Quality of Service) Settings
- RADIUS Settings
- VLAN Settings

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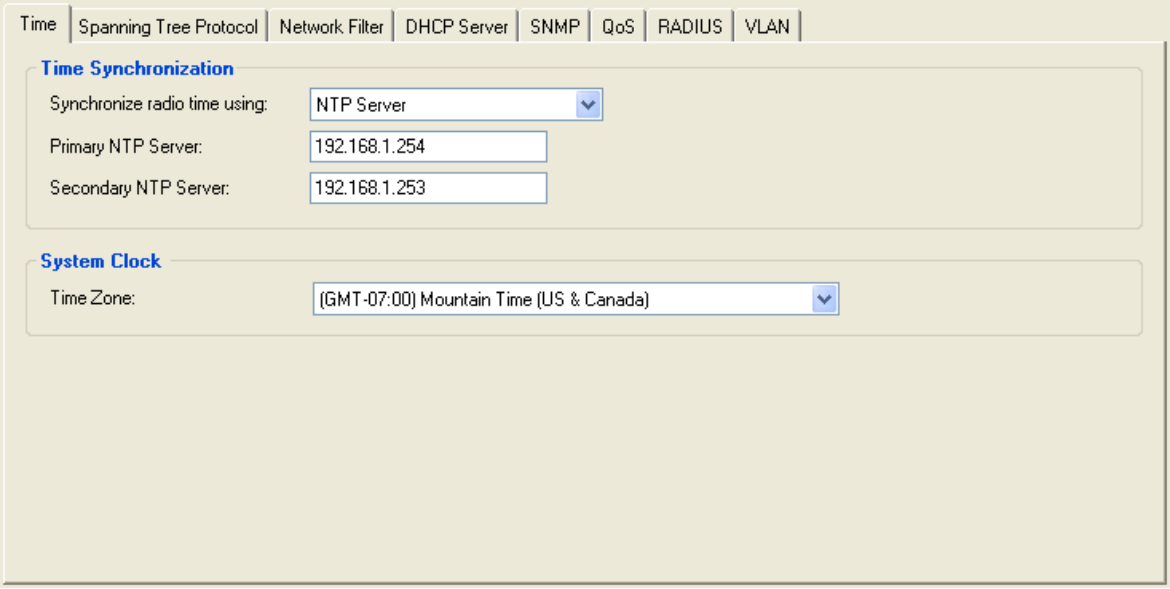
Time Settings

The following screen shot shows the NTP settings tab for a point-to-multipoint radio:



The following table describes the time synchronization settings.

<table>
<tr><th colspan="2">Time Synchronization</th></tr>
<tr><th>Field Name</th><th>Description</th></tr>
<tr><td>Synchronize radio time using</td><td>Select one of the following options to set the system clock:

<table><tr><th>Option</th><th>Description</th></tr><tr><td>Nothing</td><td>The radio's time will only be synchronized when a configuration change is made by STRATOS.</td></tr><tr><td>NTP Server</td><td>The radio will synchronize its internal clock to the specified NTP server time at regular intervals.</td></tr><tr><td>GPS Receiver</td><td>The radio will synchronize its internal clock from the built-in GPS receiver.

Note: This option is only available if the radio contains a GPS receiver.</td></tr></table></td></tr>
<tr><td>Primary NTP Server</td><td>Specify the IP address of the NTP server used to synchronize the radio's internal clock. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:</td></tr>
</table>

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	 Note: This option is only enabled when the NTP Server option is selected.
Secondary NTP Server	If applicable, specify the IP address of the secondary NTP server. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If there is no secondary NTP server in your network, enter "0.0.0.0" in this field. **Note:** This option is only enabled when the NTP Server option is selected.

System Clock	
Field Name	**Description**
Time Zone	Select the time zone in which the radio is operating. Note that the time zone has no effect on the operation of the radio, and does not need to be set for normal operation. If the time zone is not set, the radio defaults to UTC time.

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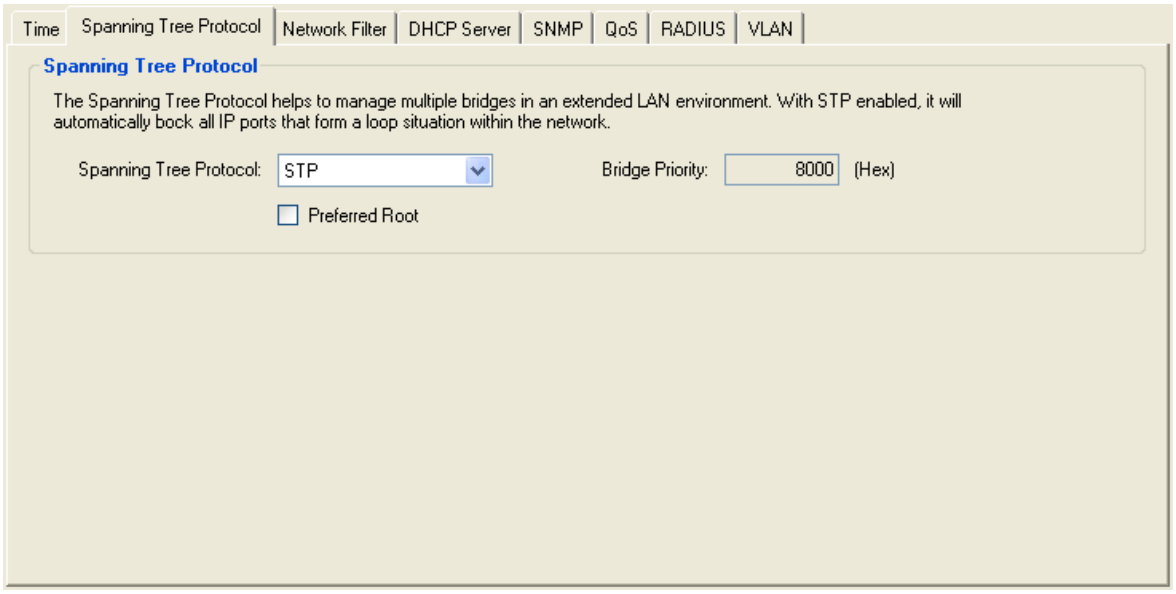
Spanning Tree Protocol Settings

The following screen shot shows the *Spanning Tree Protocol* settings tab for a point-to-multipoint radio:



The spanning tree protocols are used to prevent the formation of loops that can interfere with the proper operation of the radio network. Refer to Appendix C: Spanning Tree Protocol for more information on the this subject, and for guidance in designing a radio network that uses STP or RSTP.

The following table describes the spanning tree protocol settings.

Spanning Tree Protocol	
Field Name	**Description**
Spanning Tree Protocol	The Spanning Tree Protocol (STP) is a protocol that provides link management to prevent undesirable loops from appearing in the network. You can select from one of the following options:

Option	Description
Disabled	STP is not enabled. This is the default setting.
STP	STP is enabled.
Rapid STP	Rapid STP is enabled. This is an enhanced version of the STP protocol that provides for faster spanning tree convergence after a topology change.

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	<table><tr><td></td><td>You would normally use this option if you want to use STP in your network.</td></tr></table>
Preferred Root	Check this option if you want the radio to be preferred over other radios when the network is negotiating which radio to use as the STP root.
Bridge Priority	The STP priority that is assigned to the radio. This setting is managed by STRATOS, and cannot be changed manually. This information can be useful if you have other STP or RSTP enabled devices in your network (such as switches and routers), and you need to configure them to interact with the ENCOM radios.

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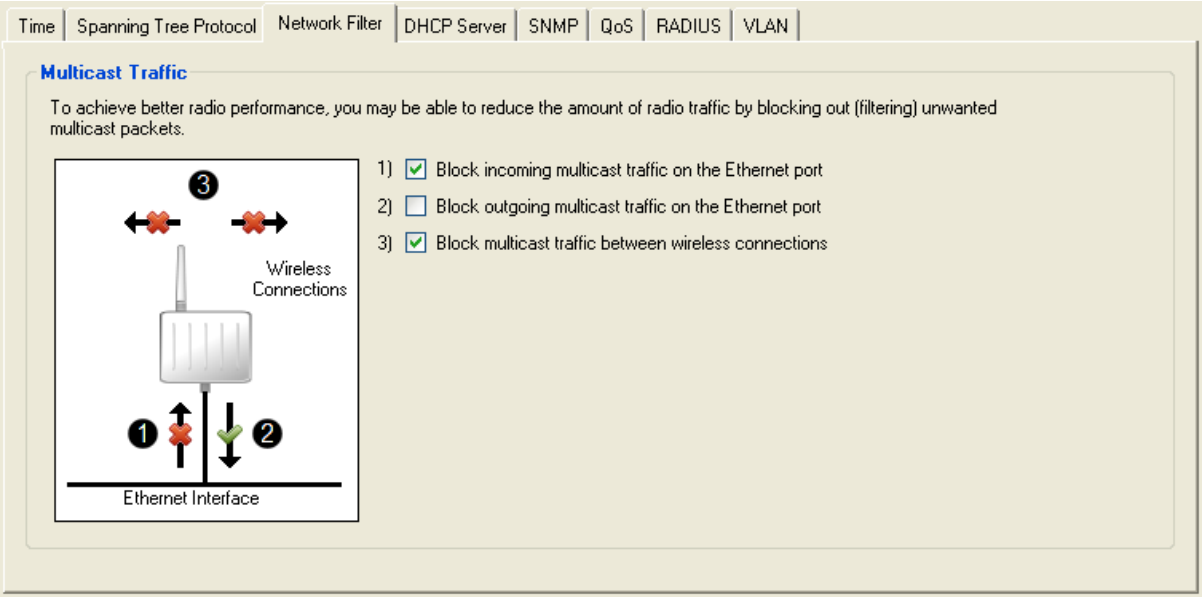
Network Filter Settings

The following screen shot shows the Network Filter tab for a point-to-multipoint radio:


Time
Spanning Tree Protocol
Network Filter
DHCP Server
SNMP
QoS
RADIUS
VLAN
Multicast Traffic
To achieve better radio performance, you may be able to reduce the amount of radio traffic by blocking out (filtering) unwanted multicast packets.
1) Block incoming multicast traffic on the Ethernet port
2) Block outgoing multicast traffic on the Ethernet port
3) Block multicast traffic between wireless connections
Wireless Connections
Ethernet Interface

The network filters are used to block multicast traffic from being forwarded by the radio. This can enhance the performance of your radio network, by eliminating unnecessary network traffic.

The following table describes the network filter settings.

Network Traffic Filtering	
Field Name	**Description**
Block incoming multicast traffic on the Ethernet port	Check this option to prevent multicast traffic arriving on the radio's Ethernet port from being forwarded to the radio's wireless interfaces.
Block outgoing multicast traffic on the Ethernet port	Check this option to prevent multicast traffic arriving on the radio's wireless interfaces from being forwarded to the radio's Ethernet port.
Block multicast traffic between wireless connections	Check this option to prevent multicast traffic arriving on one of the radio's physical radio cards, WDS links or client wireless connections from being forwarded to the other radio cards, WDS links or client wireless connections.

Note that some network protocols (such as those used by traffic cameras) use multicast packets to operate. Because of this, you must be careful when disabling these settings.

Refer to Appendix F: Network Filters for more information on setting up the network filters.

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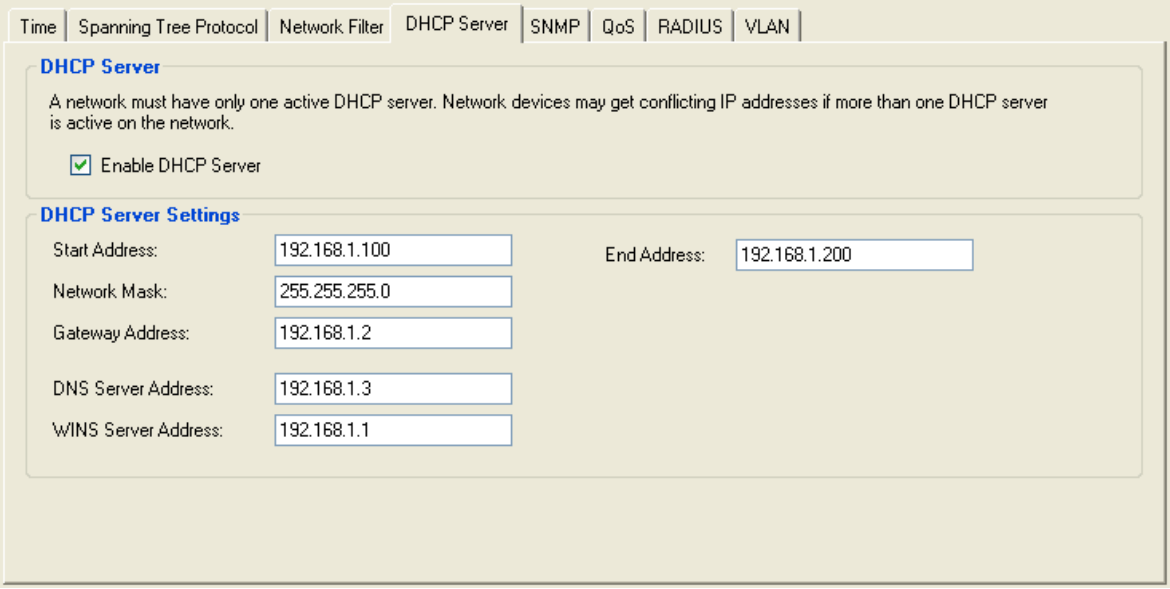
DHCP Server Settings

The following screen shot shows the DHCP server tab for a point-to-multipoint radio:



The following table describes the DHCP server settings.

DHCP Server	
Field Name	**Description**
Enable DHCP Server	Check this option to enable the radio's DHCP server. When this option is enabled, the radio will assign IP addresses to any other radio, or any other other device, that is configured to obtain their IP addresses dynamically. **Important:** Severe network instability can occur if there is more than one DHCP server present in a network or network segment. Do not enable this option if a router or another radio is already acting as a DHCP server.

DHCP Server Settings	
Field Name	**Description**
DHCP Address Range	Specify the start and end range of the IP addresses that will be provided by the DHCP server, as shown in the following example: DHCP Address Range: 192.168.1.100 to 192.168.1.200 In this example, IP addresses in the 192.168.1.100 - 192.168.1.200 range will be assigned to devices that use dynamic addressing. IP addresses outside this range would be manually assigned to devices that do not use dynamic addressing.

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DHCP Server Settings	
Field Name	**Description**
Network Mask	Enter the network mask that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:
Gateway Address	Enter the IP Address of the default gateway that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: The default gateway is the radio or router that provides access to devices outside of the local network.
DNS Server Address	Enter the IP Address of the DNS server that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If there is no DNS server available in your network, enter "0.0.0.0" in this field.
WINS Server Address	Enter the IP Address of the WINS server that will be assigned to the devices that use dynamic IP addressing. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If there is no WINS server available in your network, enter "0.0.0.0" in this field.

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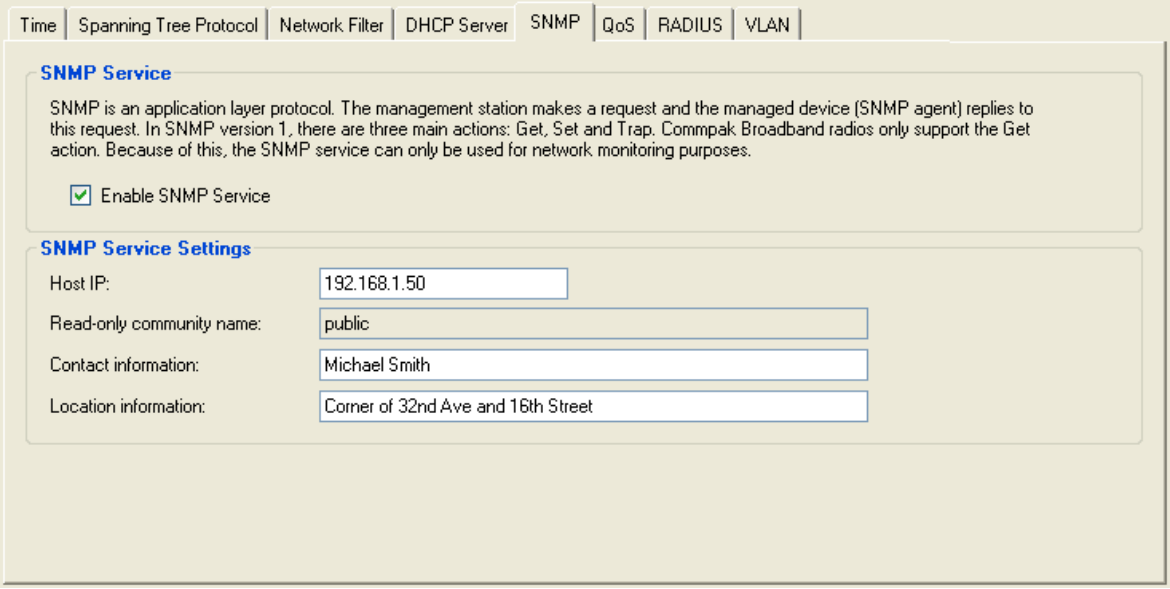
SNMP Settings

The following screen shot shows the SNMP tab for a point-to-multipoint radio:


Time
Spanning Tree Protocol
Network Filter
DHCP Server
SNMP
QoS
RADIUS
VLAN
SNMP Service
SNMP is an application layer protocol. The management station makes a request and the managed device (SNMP agent) replies to this request. In SNMP version 1, there are three main actions: Get, Set and Trap. Commpak Broadband radios only support the Get action. Because of this, the SNMP service can only be used for network monitoring purposes.
Enable SNMP Service
SNMP Service Settings
Host IP:
192.168.1.50
Read-only community name:
public
Contact information:
Michael Smith
Location information:
Corner of 32nd Ave and 16th Street

The following tables describe the SNMP service settings.

SNMP Service	
Field Name	**Description**
Enable SNMP Service	Check this option enable the radio's SNMP (Simple Network Management Protocol) agent. When this option is enabled, diagnostic information can be obtained from the radio using any SNMP based network monitoring application.

SNMP Service Settings	
Field Name	**Description**
Host IP	Enter the IP address of the computer on which the network monitoring application is running, as shown in the following example: Host IP: 192.168.1.50 Setting this option will prevent any other computer from being able to access the radio's SNMP information. If you want to allow any computer that is on your network to access the radio's SNMP information, enter "0.0.0.0" in this field.
Community Name	The community name used to access the radio's SNMP agent. This is set

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	to 'public', and cannot be changed. Only read operations are permitted.
Contact Information	Enter the contact information of the individual responsible for the network, if applicable.
Location Information	Enter the location of the radio, if applicable.

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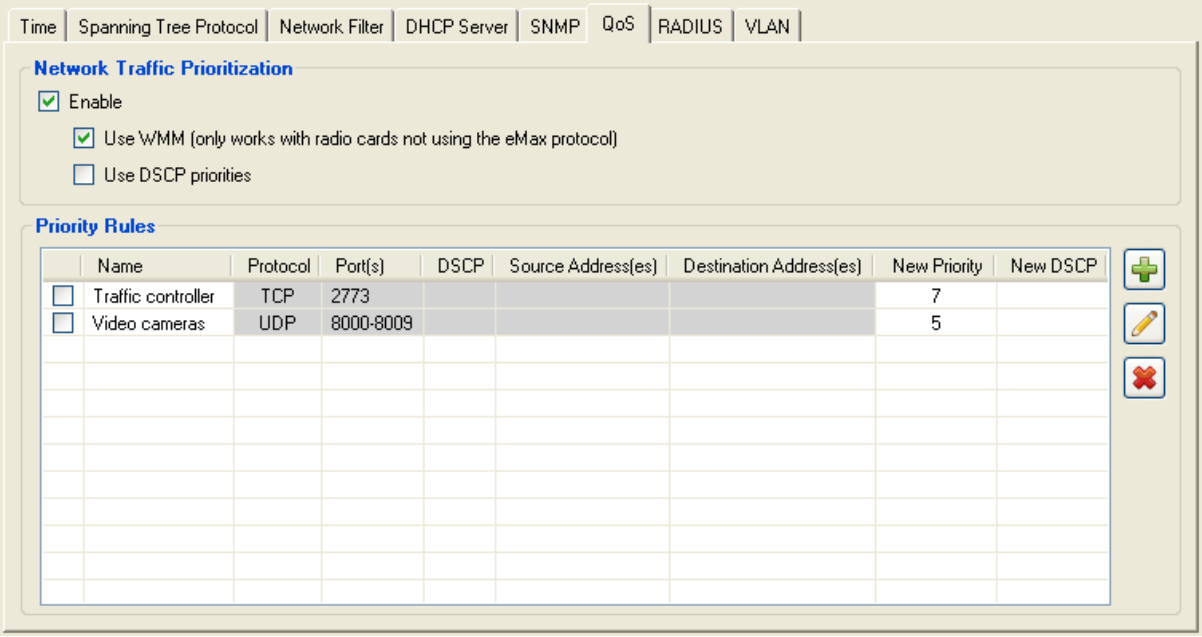
QoS Settings

The following screen shot shows the *QoS (Quality of Service)* settings tab for a point-to-multipoint radio:



The Quality of Service settings allow you to prioritize the various types of network traffic so that important traffic is processed ahead of less important traffic.

Under normal conditions, all network data packets have an equal opportunity to be forwarded by the radio. This works well for some applications (such as file transfers or web browsing) but it is not adequate for traffic that is sensitive to network latency and throughput reductions (such as voice or video streaming). QoS allows you to address this issue by giving the time sensitive traffic a larger share of the network bandwidth.

Refer to Appendix D: Quality of Service for more detailed information on the prioritization mechanisms supported by the ENCOM radios.

The following tables describe the Quality of Service settings.

Network Traffic Prioritization	
Field Name	**Description**
Enable	Check this option to enable priority queue based QoS features. Priority rules are used to specify the priority of specific types of traffic. Lower priority traffic is dropped in preference to higher priority traffic when the radio becomes heavily loaded.
Use WMM	Check this option to set the priority of incoming packets to the incoming WMM priority (or to the incoming VLAN priority if VLANs are being used).

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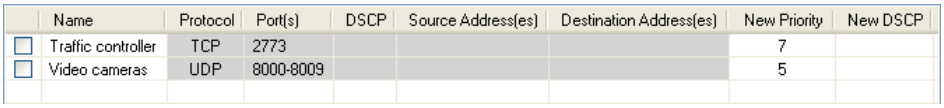
	WMM is used to prioritize certain type of traffic, such as VOIP (Voice Over IP) and video streams, that are sensitive to network latency and capacity issues. **Note:** The WMM/VLAN priorities must be set by the device that creates the network data packets or by the router or switch that provides access to the ENCOM radio network.
Use DSCP Priorities	Check this option to set the priority of incoming packets to the DSCP priority of the incoming data packets. **Note:** The DSCP priorities must be set by the device that creates the network data packets or by the router or switch that provides access to the ENCOM radio network.

Priority Rules

Field Name	Description
Priority Rule List	By default, ENCOM STRATOS will assign the highest priority to the radio management traffic. Other types of network traffic can be assigned to specific priority queues by creating custom priority rules. The **Priority Rules** list displays the custom priority rules that you have defined. When defining a priority rule, you specify the type of traffic that the rule is to act upon, and the priority to assign to the matching traffic. In the following example, two priority rules have been defined:



	Name	Protocol	Port(s)	DSCP	Source Address(es)	Destination Address(es)	New Priority	New DSCP
☐	Traffic controller	TCP	2773				7	
☐	Video cameras	UDP	8000-8009				5	

The shaded cells contain the criteria that must be matched in order for a network data packet to be affected by the rule. Matching data packets will be assigned the **New Priority** (and optionally the **New DSCP** value) defined in the rule.

The priority rule list is sorted by the **New Priority** column, in descending order.

The following table describes the information that is displayed in the **Priority Rules** list:

Column	Description
☐	To delete a rule, first check it, and then click on the **Remove** button at the right of the **Priority Rule** list to actually delete it.

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<table>
<tr><td></td><td>
<table>
<tr><td>Name</td><td>A short description that identifies the type of network traffic associated with the rule.</td></tr>
<tr><td>Protocol</td><td>The protocol to match.</td></tr>
<tr><td>Port(s)</td><td>The IP port or ports to match. If blank, traffic on any port is affected by the rule.</td></tr>
<tr><td>Source Address(es)</td><td>The address or addresses that the data packets must originate from.</td></tr>
<tr><td>Destination Address(es)</td><td>The address or addresses that the data packets are being forwarded to.</td></tr>
<tr><td>DSCP</td><td>The DSCP value of the incoming packets to match. If blank, the DSCP priority is ignored by the rule.</td></tr>
<tr><td>New Priority</td><td>The priority to assign to the packets that match the specified criteria.</td></tr>
<tr><td>New DSCP</td><td>The DSCP value to assign to the packets that match the specified criteria.</td></tr>
</table>
</td></tr>
<tr><td>
(Add button)</td><td>Click the Add button to create a new priority rule. Enter the appropriate rule settings in the QoS Priority Rule form that is displayed.</td></tr>
<tr><td>
(Edit button)</td><td>Select a priority rule, and then click on the Edit button to modify the rule settings.
Alternatively, you can double-click on the rule you want to modify.</td></tr>
<tr><td>
(Remove button)</td><td>To delete a rule, first check it, and then click on the Remove button to actually delete it.</td></tr>
</table>

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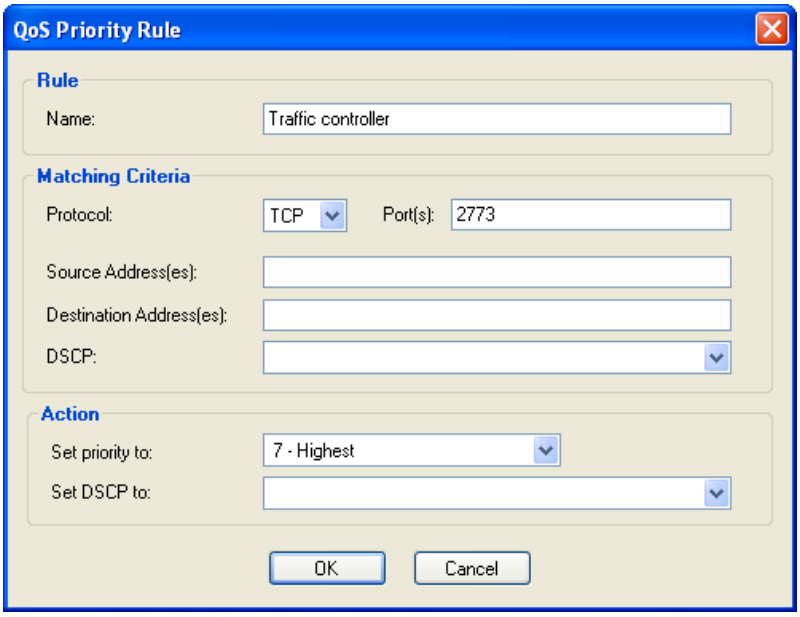
Specifying a QoS Priority Rule

The following screen shot shows the *QoS Priority Rule* form for a point-to-multipoint radio:



The *QoS Priority Rule* form allows you to define a traffic priority rule.

The following tables describe the QoS rule settings.

Rule	
Field Name	**Description**
Name	Enter a short description that identifies the type of network traffic associated with the rule.

Matching Criteria	
Field Name	**Description**
Protocol	Specify the protocol that the rule will apply to. You can select one of the following values: **Protocol** / **Description** All / All network traffic will be matched. When you select this option, one or both of the **Source Address** and **Destination Address** fields must be set. Otherwise, all of the network traffic flowing through the radio would match the

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<table>
<tr><td></td><td>
<table>
<tr><td></td><td>rule.</td></tr>
<tr><td>UDP</td><td>The rule will only affect UDP traffic.</td></tr>
<tr><td>TCP</td><td>The rule will only affect TCP traffic.</td></tr>
</table>
</td></tr>
<tr><td>Ports</td><td>Optionally specify the port or ports associated with the network traffic that the rule will apply to. You can specify the ports using one of the following formats:
<table>
<tr><th>Format</th><th>Example</th></tr>
<tr><td>Single Port</td><td>1000</td></tr>
<tr><td>Multiple Ports</td><td>1000,2000</td></tr>
<tr><td>Port Range</td><td>1000-2000</td></tr>
<tr><td>Multiple Port Ranges</td><td>1000-2000,3000-4000</td></tr>
</table>
If this value is not specified, the rule will apply to all traffic of the selected protocol type.</td></tr>
<tr><td>Source Address(es)</td><td>Optionally specify the address or addresses that the data packets must originate from. You can specify the addresses using one of the following formats:
<table>
<tr><th>Format</th><th>Example</th></tr>
<tr><td>Single IPV4 Address</td><td>192.168.1.100</td></tr>
<tr><td>IPV4 Address Range</td><td>192.168.1.100-192.168.1.200</td></tr>
<tr><td>IPV4 CIDR Subnet</td><td>192/168.1.1/24</td></tr>
</table>
If this value is not specified, the rule will apply to all destination addresses.</td></tr>
<tr><td>Destination Address(es)</td><td>Optionally specify the address or addresses that the data packets are being forwarded to. You can specify the addresses using one of the following formats:
<table>
<tr><th>Format</th><th>Example</th></tr>
<tr><td>Single IPV4 Address</td><td>192.168.1.100</td></tr>
</table></td></tr>
</table>

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	<table><tr><td>IPV4 Address Range</td><td>192.168.1.100-192.168.1.200</td></tr><tr><td>IPV4 CIDR Subnet</td><td>192/168.1.1/24</td></tr></table> If this value is not specified, the rule will apply to all destination addresses.
DSCP	Optionally specify the DSCP (Differentiated Services Code Point) value in the IP header that the rule will apply to. You can select a predefined DSCP value from the drop-down list, or enter a number between 0 and 63. If this value is not specified, the rule will apply to all DSCP values.

Action	
Field Name	**Description**
Set priority to	The priority to assign to the packets that match the specified criteria. The higher the priority value, the higher the priority assigned to the associated network traffic.
Set DSCP to	Optionally specify the DSCP (Differentiated Services Code Point) value to assign to the packets that match the specified criteria. You can select a predefined DSCP value from the drop-down list, or enter a number between 0 and 63. If this value is not specified, no change will be made to the packet's DSCP value.

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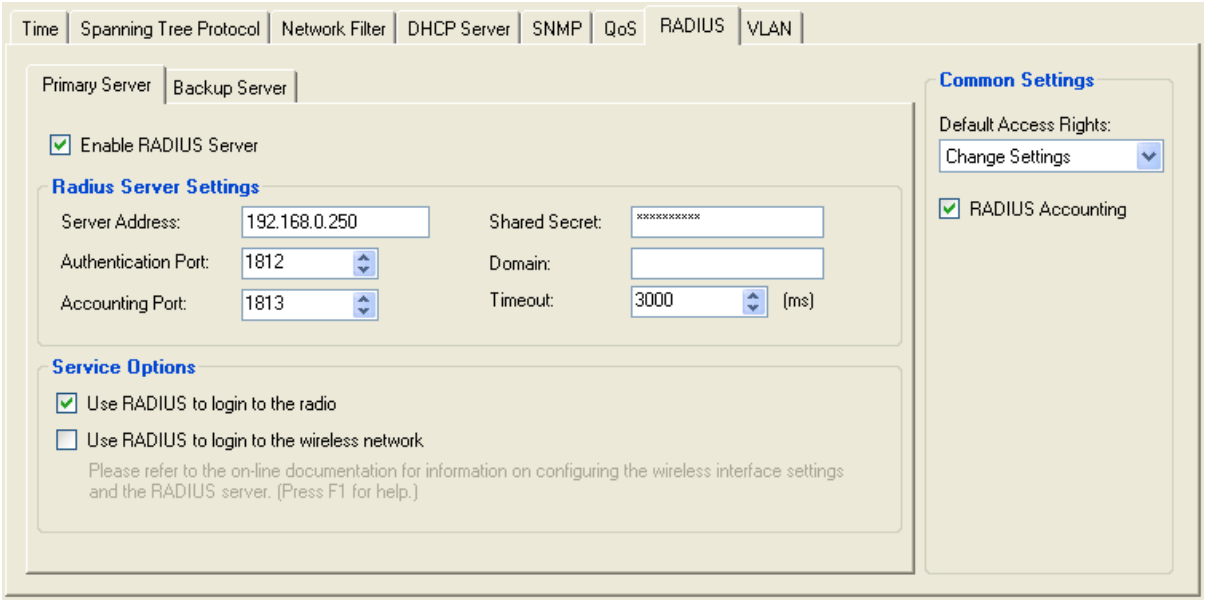
RADIUS Settings

The following screen shot shows the *RADIUS* settings tab for a point-to-multipoint radio:



RADIUS is used to centralize the authentication of users that attempt to login to the radio and/or to the network. Refer to **ENCOM STRATOS RADIUS Configuration Guide**, available separately, for more information on setting up and using a RADIUS server with your radio network.

The following tables describe the settings found in each group in the RADIUS settings tab.

Primary and Secondary Server	
Field Name	**Description**
Enable RADIUS Server	Check this setting to enable the associated RADIUS server (Primary or Backup). If the radio cannot connect to the primary RADIUS server, it will attempt to connect to the backup RADIUS server.
Server Address	Enter the IP address of the RADIUS server.
Authentication Port	Enter the IP port on which RADIUS authentication requests are accepted. The default is 1812.
Accounting Port	Enter the IP port on which RADIUS accounting updates are accepted. The default is 1813.
Shared Secret	Enter a string that is used to obfuscate the user password that is sent to the RADIUS server for authentication. This value must match the Shared Secret that is configured in the RADIUS server.

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Domain	Enter the Microsoft Windows domain of the user. Only use if the RADIUS server requires domain validation.
Timeout	Enter the maximum amount of time (in milliseconds) to wait for a response from the RADIUS server before resending an authentication request. The default is 300 ms. You may need to increase this if your RADIUS server is slow to respond to authentication requests.
Use RADIUS to login to the radio	Check this option to use RADIUS to authenticate radio login requests. When this option is enabled, the radio will check with the RADIUS server if it does not find the specified user in its local user database.
User RADIUS to login to the wireless network	Check this option to use RADIUS to authenticate client devices that wish to attach to your network (e.g. for access to the network operations center or to your corporate LAN). If you select this option, you will need to check the RADIUS MAC Authentication setting for each of the radio cards that clients will use to connect to the network.

Common Settings

Field Name	Description
Default Access Rights	Select the access rights to assign to the user if the RADIUS server is not configured to respond to an authentication request with the user's group name. The following table describes the options that are available for this setting: **Option** / **Description** View Settings — The user will be able to inspect the radio's configuration settings, but will not be able to make any changes. Change Settings — The user will be able to inspect and change the radio's configuration settings. This setting is ignored if the RADIUS server responds to an authentication request with the user's group name.
RADIUS Accounting	Check this option to send RADIUS accounting packets to the RADIUS server. This information is normally used for user billing, and is not usually needed for typical ENCOM radio networks.

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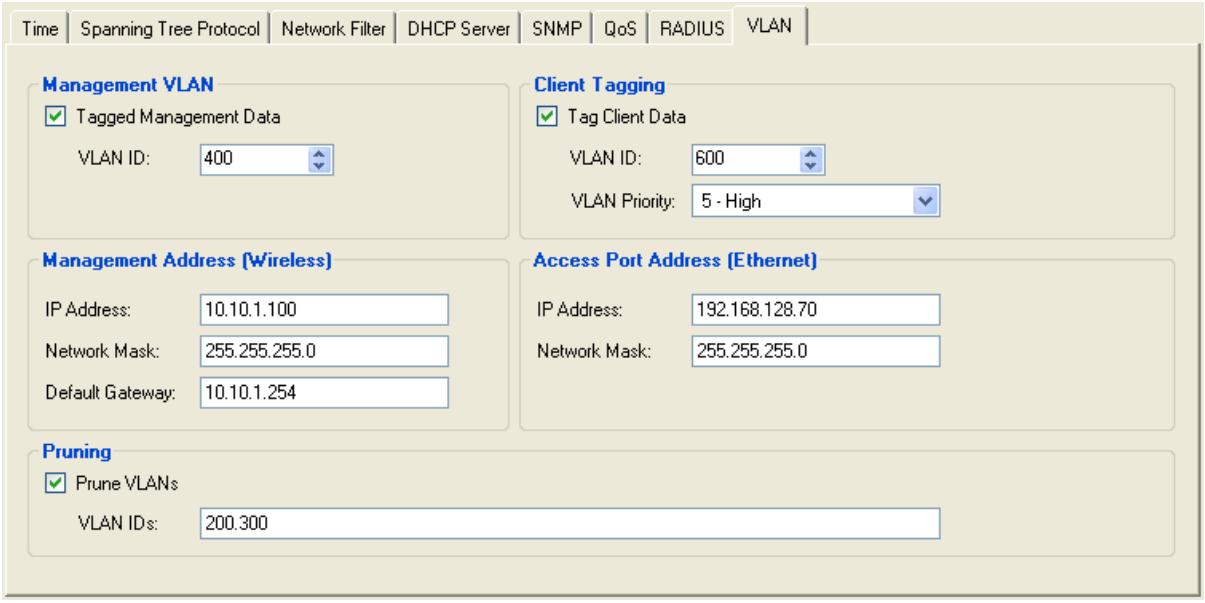
VLAN Settings

The following screen shot shows the *VLAN* settings tab for a point-to-multipoint radio:



VLANs (Virtual LANs) are used to improve the performance, and possibly the security, of a radio network. Refer to Appendix E: VLAN Support for more information on implementing a VLAN-based network.

The following tables describe the settings found in each group in the VLAN settings tab.

Management VLAN	
Field Name	**Description**
Tagged Management Data	By default, the radio can be managed by connections over the native (non-tagged) VLAN. To be able to manage the radio using a specific VLAN, check this option, and enter the appropriate management VLAN ID in the **VLAN ID** field.
VLAN ID	Enter the ID of the management VLAN (a number in the range 1-4095 is required).

Client Tagging	
Field Name	**Description**
Tag Client Data	Normally, all of the radio's interfaces (wireless and Ethernet) act as VLAN trunks (i.e. they carry the network traffic for all VLANs). If a normal, non-VLAN aware device is plugged into the radio's Ethernet port, its network traffic will not be tagged, and it will not be able to communicate with

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	devices that are part of a VLAN. Check this option to set up the radio's Ethernet port as an access port for a specific VLAN. This gives devices connected to the Ethernet port access to the other devices in the specified VLAN.
VLAN ID	Enter the ID of the client VLAN to (a number in the range 1-4095 is required).
VLAN Priority	The priority to assign to the packets originating from the Ethernet port. The higher the priority value, the higher the priority assigned to the associated network traffic. **Note:** In order to prioritize the wireless network traffic using the VLAN priority, the appropriate QoS options need to be configured. See the Using WMM to Support VLAN Priority Traffic topic for more information.

Management Address (Wireless)

Field Name	Description
IP Address	Enter the IP address used to access the radio via its wireless interfaces. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tagged Management Data** option is checked, this IP address should be compatible with the management VLAN's network address range.
Network Mask	Enter the network mask of the network used to access the radio via its wireless interfaces. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tagged Management Data** option is checked, this mask should be compatible with the management VLAN's network mask.

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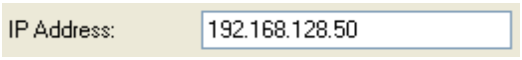
Default Gateway	Enter the IP address of the radio, router or switch that allows this radio to connect with devices that are outside of their local LAN or VLAN. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tagged Management Data** option is checked, this IP address would normally be the IP address of the network's gateway radio, or the IP address of the router or switch used to access external networks.

Access Port Address (Ethernet)

Field Name	Description
IP Address	Enter the IP address used to access the radio via its Ethernet interface. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example:  If the **Tag Client Data** option is checked, this IP address should be compatible with the client VLAN's network address range.
Network Mask	Enter the network mask of the network used to access the radio via its Ethernet interface. This is an Internet Protocol version 4 (IPv4) address, specified in dotted notation, as shown in the following example: If the **Tag Client Data** option is checked, this mask should be compatible with the client VLAN's network mask.

Pruning

Field Name	Description
Prune VLANs	Check this option to prevent the radio for forwarding network traffic associated with specific VLAN IDs.
VLAN IDs	Enter one or more VLAN IDs to prune. Separate individual IDs with commas. Any incoming network traffic that matches the specified VLAN IDs will be dropped by the radio.

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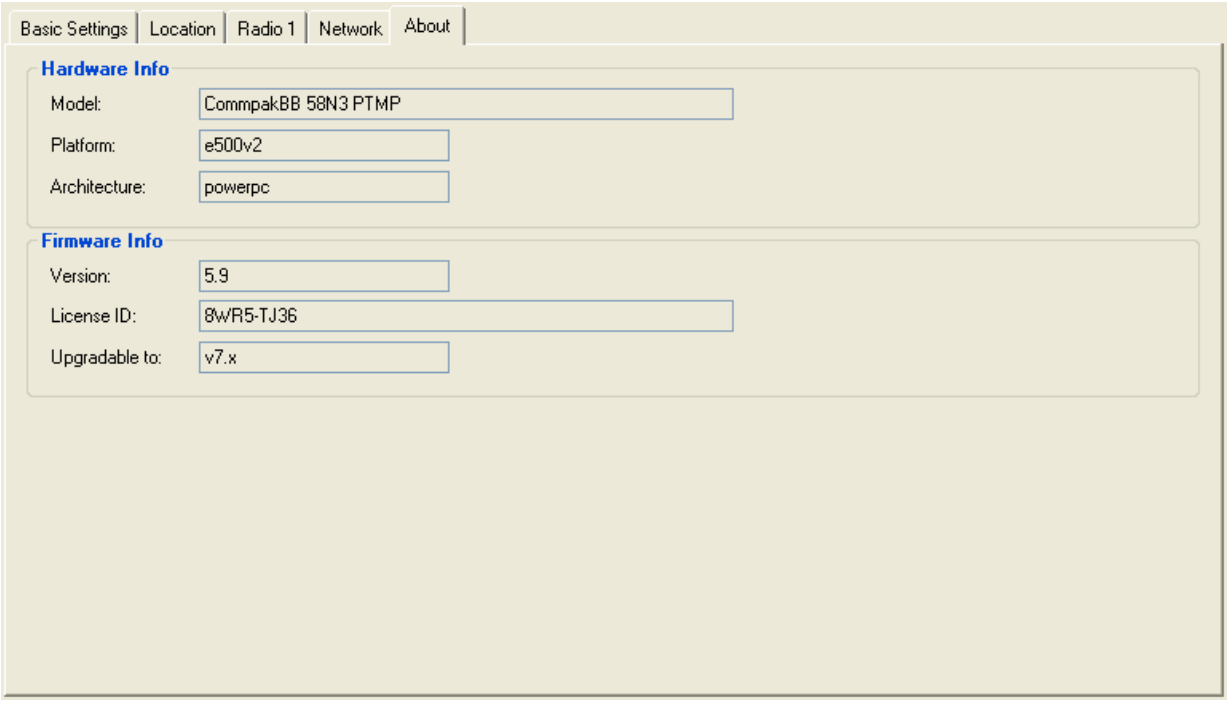
About Tab

The following screen shot shows the About tab for a point-to-multipoint radio:



This tab displays information regarding the radio's hardware and firmware. It does not contain any user editable fields.

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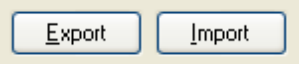
Export and Import Buttons

The **Export** and **Import** buttons in the lower left-hand corner of the radio configuration form allow you to save the radio's configuration settings to a file, and to update the radio's configuration settings from a previously saved configuration file.



Refer to the following topics for more information on these functions:

- Exporting the Radio Configuration
- Importing the Radio Configuration

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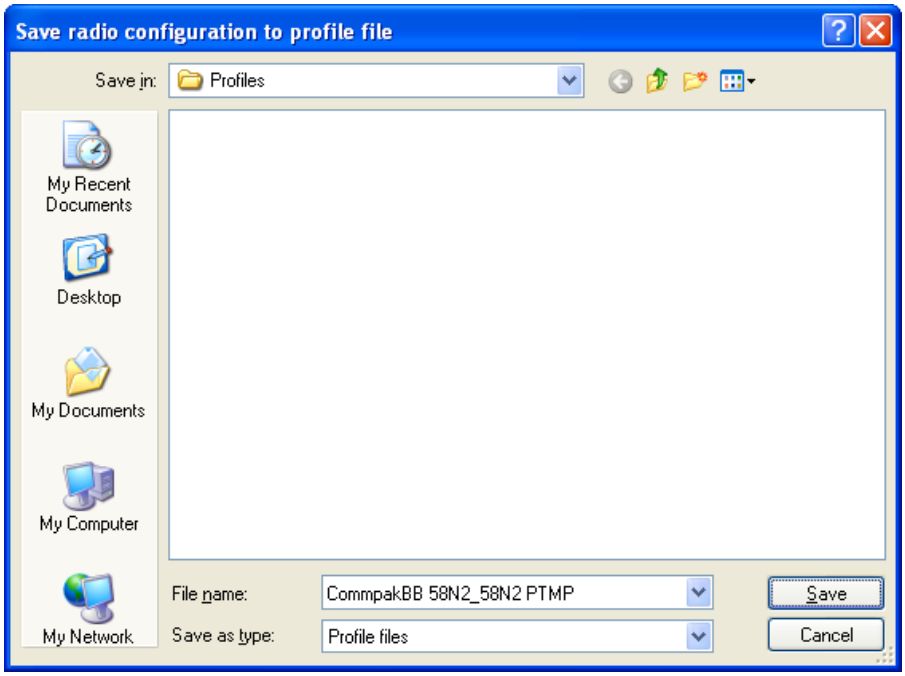
Exporting the Radio Configuration

The **Export** function is used to save the radio's current settings to a configuration profile file. This allows you to:

- Make a backup copy of the radio's configuration.
- Save the radio's configuration to a profile or template file for use in configuring other radios.

To export a radio's configuration:

1. From the radio's configuration form, click on the **Export** button. The *Save configuration profile file* form is displayed:



2. Specify the name of the file you want to save the radio's configuration settings to, and then press the **Save** button to save the settings.

   By default, STRATOS saves configuration profile files in the *'My Documents\Encom Wireless\Profiles'* folder.

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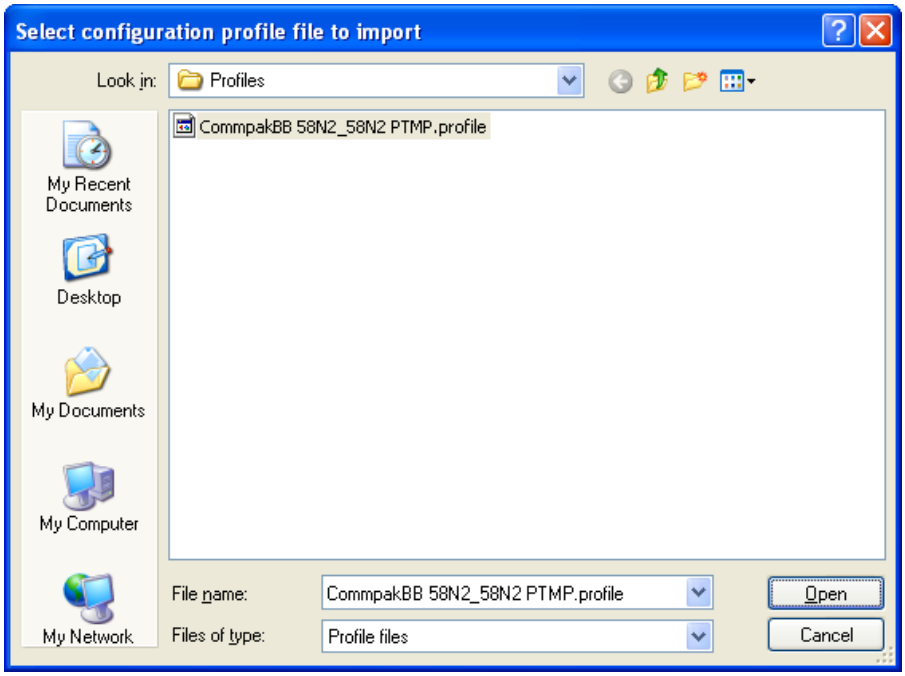
Importing the Radio Configuration

The **Import** function allows you to update the radio's settings from a previously saved configuration profile file. This function allows you to:

- Restore the radio's configuration from a backup file. This can be useful when you have to replace a radio in the field.
- Apply the settings from one radio to another. This can be used to provision new radios quickly, and ensure that they are compatible with other radios in the network.

To configure a radio using a saved configuration file:

1. From the radio's configuration form, click on the **Import** button. The *Select configuration profile file* form is displayed:



2. Select the configuration profile you want to import, and press the **Open** button.

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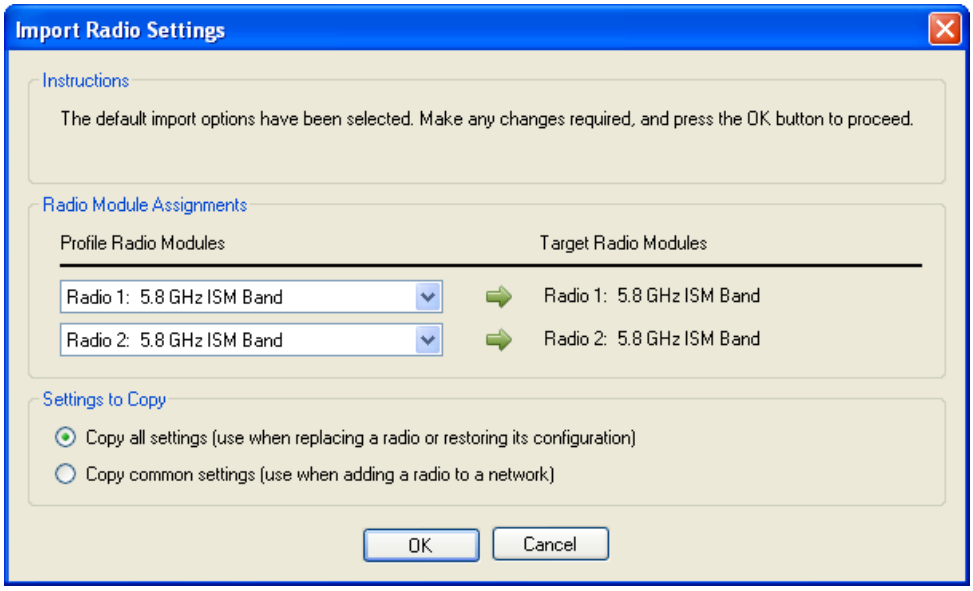
3. The *Import Radio Settings* form will be displayed:


Import Radio Settings
Instructions
The default import options have been selected. Make any changes required, and press the OK button to proceed.
Radio Module Assignments
Profile Radio Modules
Target Radio Modules
Radio 1: 5.8 GHz ISM Band
Radio 1: 5.8 GHz ISM Band
Radio 2: 5.8 GHz ISM Band
Radio 2: 5.8 GHz ISM Band
Settings to Copy
Copy all settings (use when replacing a radio or restoring its configuration)
Copy common settings (use when adding a radio to a network)
OK
Cancel

4. The *Radio Module Assignments* group allows you to specify how the radio module settings are applied:

Profile Radio Modules
Target Radio Modules
Radio 1: 5.8 GHz ISM Band
Radio 1: 5.8 GHz ISM Band
Radio 2: 5.8 GHz ISM Band
Radio 2: 5.8 GHz ISM Band

The **Target Radio Modules** column lists the wireless radio modules that are present on the radio.

The **Profile Radio Modules** column shows the options that are available for each wireless interface that is present on the radio. STRATOS will find the best match between the profile and target radio modules, and will assign these by default. You can change the default assignments by selecting the appropriate items from the list boxes.

In the example shown above, STRATOS applied the matching radio modules from the profile to the target radio modules. If you didn't want to disturb the configuration of the second radio module, then you would select the **Don't Copy** option from the second list box, as shown below:

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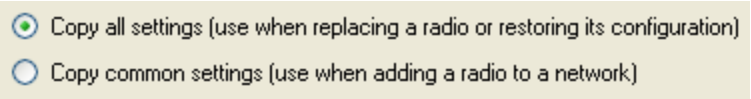
5. The **Settings to Copy** options allow you to specify what settings to import from the configuration profile:


Copy all settings (use when replacing a radio or restoring its configuration)
Copy common settings (use when adding a radio to a network)

These are described further in the following table:

Option	Description
Copy all settings	Use this option when you need to configure a radio so that it matches the configuration profile exactly. This option is most often used when configuring a replacement radio, or you want to restore the radio's configuration from a backup.
Copy common settings	Use this option to exclude those settings that are unique to the radio. This option is most often used when you are adding a new radio to a network, and you want to configure it to match the other radios in the network. The following items will **not** get copied over from the profile file to the radio: • Radio name • Radio Description • Radio latitude, longitude and street address • Radio static IP address • Parent radio MAC address • Static WDS assignments

6. Press the **OK** button to apply the profile settings to the radio.
7. Make any changes to the imported settings in the radio configuration form.
8. Press the **Save** button on the radio configuration form to save the settings to the radio.

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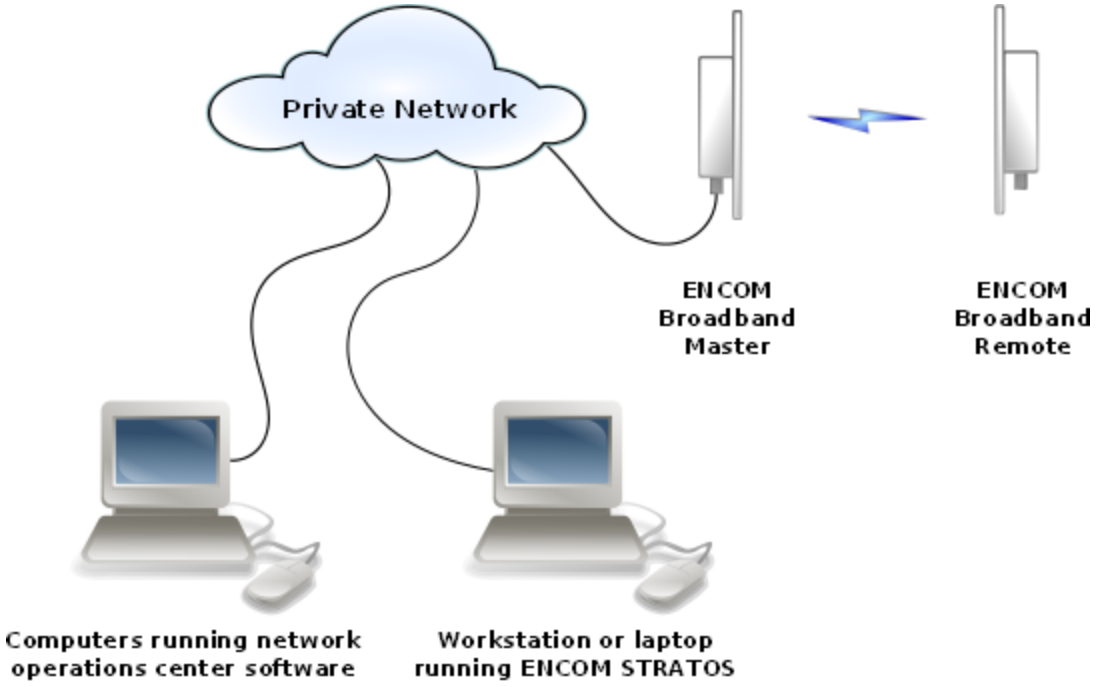
Chapter 5: Setting up a Broadband Network

This example will show you how to set up a simple broadband network consisting of a master and a remote radio.

The two radios are linked by a single wireless connection. Directional antennas are used to provided the best possible range and signal quality.



The following topics describe how to set up the broadband network:

- Assigning IP Addresses
- Setting up the Master Radio
- Setting up the Remote Radio
- Testing the Wireless Connection
- Deploying the Radios
- Optimizing to Minimize Noise Interference

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Assigning IP Addresses

If you are using new radios, you have to configure them with IP addresses that are compatible with your private local network. Perform the following steps for each of the radios:

1. Run the ENCOM STRATOS application.
2. Connect the radio directly to your workstation or laptop. (Refer to the Connecting to a Radio topic for more info.)
3. The radio will automatically be discovered by ENCOM STRATOS and appear in the Radio List panel.
4. Use the Assign Static IP Address function to assign a new IP address to the radio. The new address should be compatible with your local network. (The default IP address assigned by ENCOM is 192.168.0.1).

NOTE	Make sure that you assign different IP addresses to the master and remote radios. Assigning the same IP address to two or more radios will negatively affect the performance of your network, and will interfere with the radio configuration process.

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Setting up the Master Radio

To set up the master radio:

1) Ensure that the radio has been assigned an IP address that is compatible with your local network (see the Assigning IP Addresses topic)

2) Double-click on the radio. The Radio Configuration form will be displayed. Enter the appropriate login credentials if prompted for them. The default user name is "admin" and the default password is empty.

   a) Select the Basic Settings tab. Configure the basic settings as required.

   b) Select the Location tab. Choose the desired icon color, and select the Master icon. Select the appropriate geographical location on the map.

   c) Select the Radio 1 Tab. Configure the *Radio Network Setup* and *Radio Parameter Setup* sections.

      Because this is a master radio, set the **Radio Mode** option to **Master**. The remaining options can be left to their default values.

   d) Press the **OK** button to save the changes made to the radio configuration.

NOTE	Most of the settings in the Radio 1 tab must be the same for both the master and remote radios. If they are different, the two radios may not be able to communicate with each other.

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Setting up the Remote Radio

To set up the remote radio:

1) Ensure that the radio has been assigned an IP address that is compatible with your local network (see the Assigning IP Addresses topic)

2) Double-click on the radio. The Radio Configuration form will be displayed. Enter the appropriate login credentials if prompted for them. The default user name is "admin" and the default password is empty.

   a) Select the Basic Settings tab. Configure the basic settings as required.

   b) Select the Location tab. Choose the desired icon color, and select the Master icon. Select the appropriate geographical location on the map.

   c) Select the Radio 1 Tab. Configure the *Radio Network Setup* and *Radio Parameter Setup* sections.

      Because this is a remote radio, set the **Radio Mode** option to **Remote**. The remaining options can be left to their default values.

   d) Press the **OK** button to save the changes made to the radio configuration.

NOTE	Most of the settings in the Radio 1 tab must be the same for both the master and remote radios. If they are different, the two radios may not be able to communicate with each other.

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Testing the Wireless Connection

After configuring the master and remote radios, and prior to deployment, you should test them in bench or lab setting. The following steps outline the testing process for the two radios:

1. Connect the master radio directly to your computer via its Ethernet port.
2. Place the remote radio a reasonable distance away from the master. Don't bother aligning the antennas. In fact, since the radios will be in such close proximity to each other, you may want to mis-align the antennas so that the signal strength is not too high.
3. Apply power to both radios.
4. Run ENCOM STRATOS on your computer.
5. The master and remote radios should show up in the Radio List panel as being on-line.
6. Select the master radio. The Wireless Link Status panel should display the wireless link established between the master and remote radios.
7. Perform a Bandwidth Test to verify that the wireless connection is able to transfer data at a reasonable rate.

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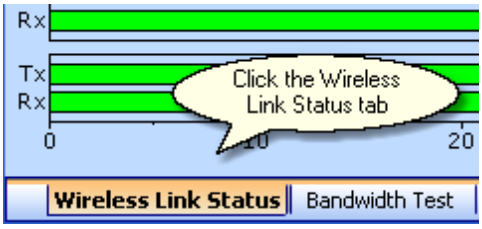
Deploying the Radios

After the radios have been configured and tested, they are ready to be deployed. The following steps outline the deployment process for this simple network.

1. Connect the master radio directly to your private network via its Ethernet port.
2. Install the remote radio at the remote location. Mount the remote antenna at the highest possible location (for example, a tower or the luminaire of a traffic light). Make sure that there is a clear line of sight between the master and the remote antennas.
3. Manually align the antennas so that they point to each other with reasonable accuracy. Since the antennas are highly directional, they need to be positioned properly in order for a connection to be established. Also, make sure that both of the antennas are installed so that the polarization stickers at the back of the antennas face the same direction.
4. Apply power to both radios.
5. Run ENCOM STRATOS on a computer that is connected to your private network.
6. The master and remote radios should show up in the Radio List panel as being on-line.
7. Make sure that the Wireless Link Status panel is visible. If it is not currently visible:
   - In the main menu, navigate to the **View -> Panels** item, and verify that the **Wireless Link Status** option is checked.
   - If the *Wireless Link Status* panel is hidden behind another panel, click on the *Wireless Link Status* tab to bring it to the front of the other panels:



8. In the Radio List, select the master radio (this is the radio that is closest to the computer running STRATOS). If the antennas are properly aligned, the Wireless Link Status panel should display the wireless links established between the master and remote radios.
9. Select the wireless link that is associated with the remote radio whose antenna you want to align.
10. Manually adjust the master and remote antennas by small increments until you get the best signal strength (RSSI) and connection quality (CCQ) readings. If you must decide, choose a better connection quality over a better signal strength.
11. Physically tighten the antennas to their mountings. There should be no possibility of the antenna moving out of alignment due to high winds, loading from ice and snow, etc.).

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12. Repeat steps 9 and 11 for each antenna pair that you need to align.

NOTE	Connection Quality is a more important factor than Signal Strength, as it tells you if the signal will be stable (high connection quality) or unstable (low connection quality). You should always attempt to achieve the highest possible Connection Quality for each radio link in the system.

NOTE	The signal strength for any particular link should be between -40 dBm and -70 dBm, with -55 dBm being ideal. A signal strength above -40 dBm may lead to degraded performance because the signal is too strong. Lower the radio's output power to get a suitable signal strength. A signal strength below -65 dBm could cause intermittent connectivity on the link. You may need to add a repeater in the network to raise the signal strength to a suitable value.

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Optimizing to Minimize Noise Interference

You can minimize noise interference in your network by changing the polarization of the antennas to the horizontal plane

- For integrated antenna systems:

  Mount the antenna so the polarization sticker is in the horizontal direction. There is a sticker on the back of each broadband integrated radio that allows you to determine the direction of the polarization.

When the radio is mounted with the Ethernet connector facing down, the antenna has a vertical polarization.

To change to horizontal polarization, rotate the radio's mounting position 90 degrees so that the Ethernet connector is facing to the right or to the left of the radio.

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- For non-integrated antenna systems:

  Non-integrated units do not have polarization stickers, but can be properly oriented by changing the direction the antenna elements are facing.

  If a non-integrated antenna's elements are pointing up and down (the elements are running parallel to the pole), it is in the vertical position and has vertical polarization.

  To change the polarization to horizontal, rotate the antenna 90 degrees, so the antenna's elements are parallel to the ground.

NOTE	If possible, mount the antenna away from other radio equipment.

WARNING	**It is important to hermetically seal the connectors to prevent water ingress. If possible, you should install the radios with the Ethernet connector at the bottom. Make sure that all cables and connectors are appropriately sealed.**

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Appendix A: RF Exposure

FCC

This equipment has been designed to comply with FCC RF exposure requirements outlined in Parts 2.1091, 2.1093, and 15.247(b)(4). Deviation from the recommended installation may violate RF exposure requirements.

To comply with FCC RF exposure requirements for mobile transmitting devices, only use or install this transmitter at locations where there is at least 23cm (9") separation distance between the antenna and all persons.

Health Canada

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population; consult Safety Code 6, obtainable from Health Canada's website at http://dsp-psd.pwgsc.gc.ca/Collection/H46-2-99-237E.pdf.

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Appendix B: Declaration of Conformity

FCC

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference

(2) This device must accept any interference received including interference that may cause undesired operation.

Warning (Part 15.21)

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Industry Canada

This device complies with Industry Canada RSS-210 specifications.

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Appendix C: Spanning Tree Protocol

STP (Spanning Tree Protocol) and RSTP (Rapid Spanning Tree Protocol) are used to ensure that bridge loops are not created between the radios in a network. Loops cause broadcast and multicast traffic to accumulate in the network until it is unable to transport normal traffic.

STP and RSTP also allow the network to define spare (redundant) links to provide automatic backup paths if an active link fails, without having to manually enable or disable the spare links.

When STP or RSTP is enabled, the radios in the network will decide amongst themselves which radio will be the STP root radio. This is the radio toward which all other radios will send their network traffic.

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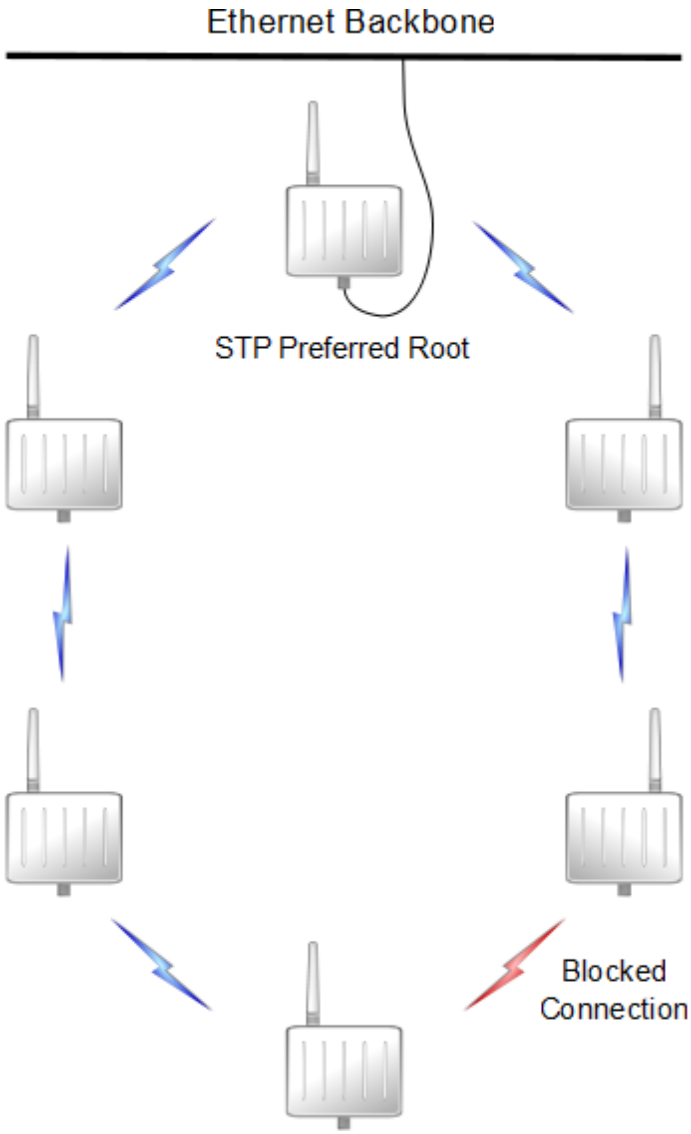
In the following example, a network of radios is organized in a simple loop. The radio that is physically connected to the network operation center's Ethernet backbone is configured as the wireless network's STP preferred root.

Although the radios are physically connected in a loop, STP or RSTP will prevent packets from being infinitely forwarded around the loop. What effectively happens is that one of the radio connections is automatically blocked to prevent a loop from being formed. In the example, the blocked link is shown in red.



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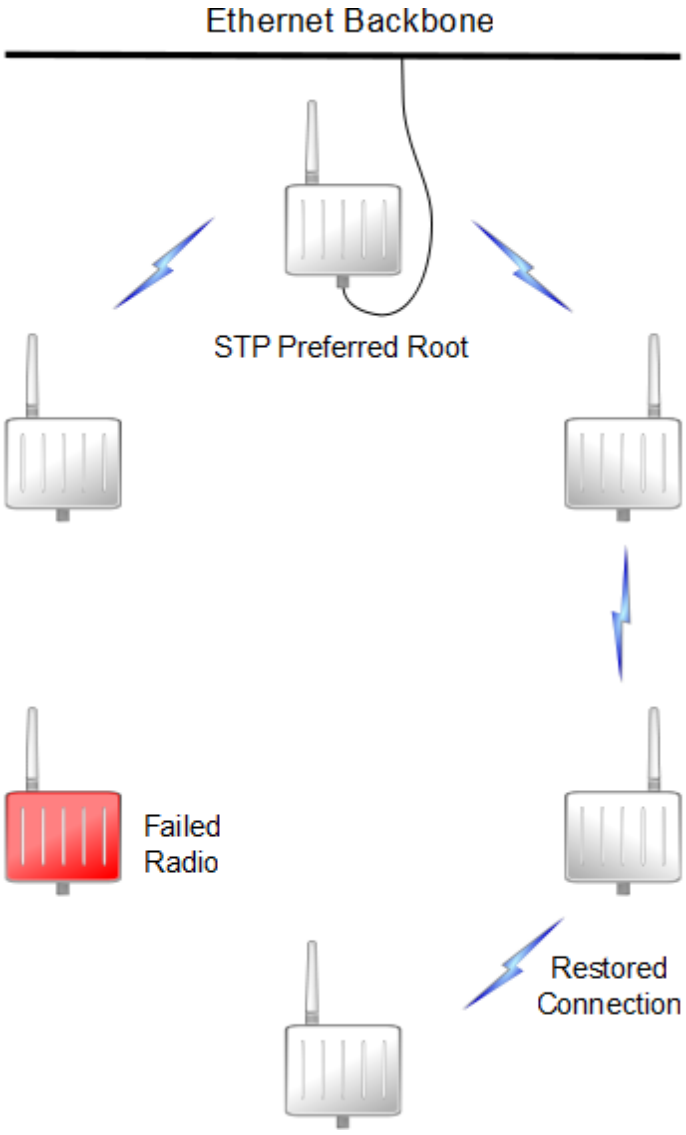
If one of the radios fails, or one of the wireless links becomes compromised, STP or RSTP will automatically reconfigure the network so that the remaining radios are still able to communicate with each other. In the following example, a radio has failed (shown in red). The connection that had previously been blocked is now re-enabled to ensure that the remaining good radios are still able to communicate.



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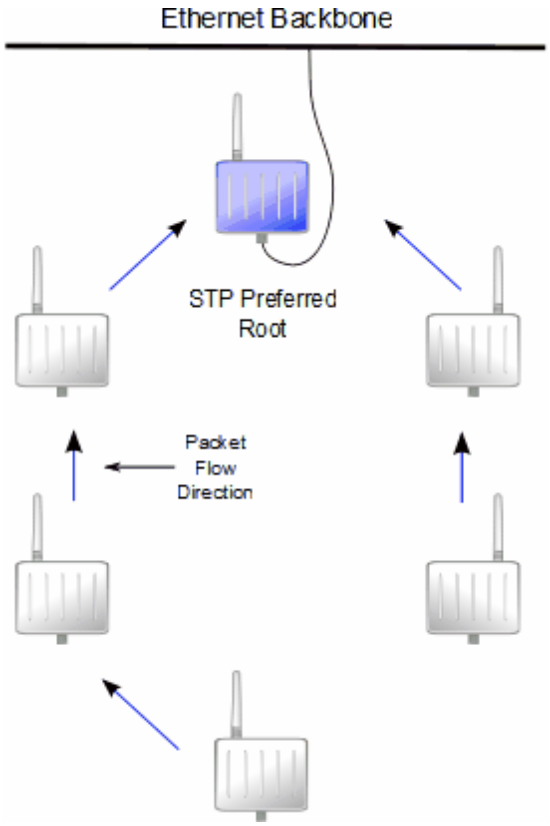
Selecting the STP Preferred Root

When STP or RSTP is enabled, the radios will decide amongst themselves which radio is the STP root radio. The STP root radio is the radio toward which all other radios will send their network traffic. In some cases, the radios may not make an optimal decision, and may lead to a network that is not operating at peak efficiency.

The Preferred Root option allows you to force the network to elect a specific radio as the STP root radio. You would normally use the following two criteria to determine if a radio should be configured as an STP preferred root:

- The radio is physically connected to the network operation center's Ethernet backbone.
- The radio is physically located at the center of a large radio network.

In the first case, it is logical that a radio connected to the Ethernet backbone (i.e. a gateway radio) be used as the STP root radio. Most of the network traffic will flow through this radio as commands and controls are sent from the network operations center to the radios, and data is sent from the radios to the network operations center. Making this radio the STP root will force the radios in the network to choose the shortest possible path to the network operations center.



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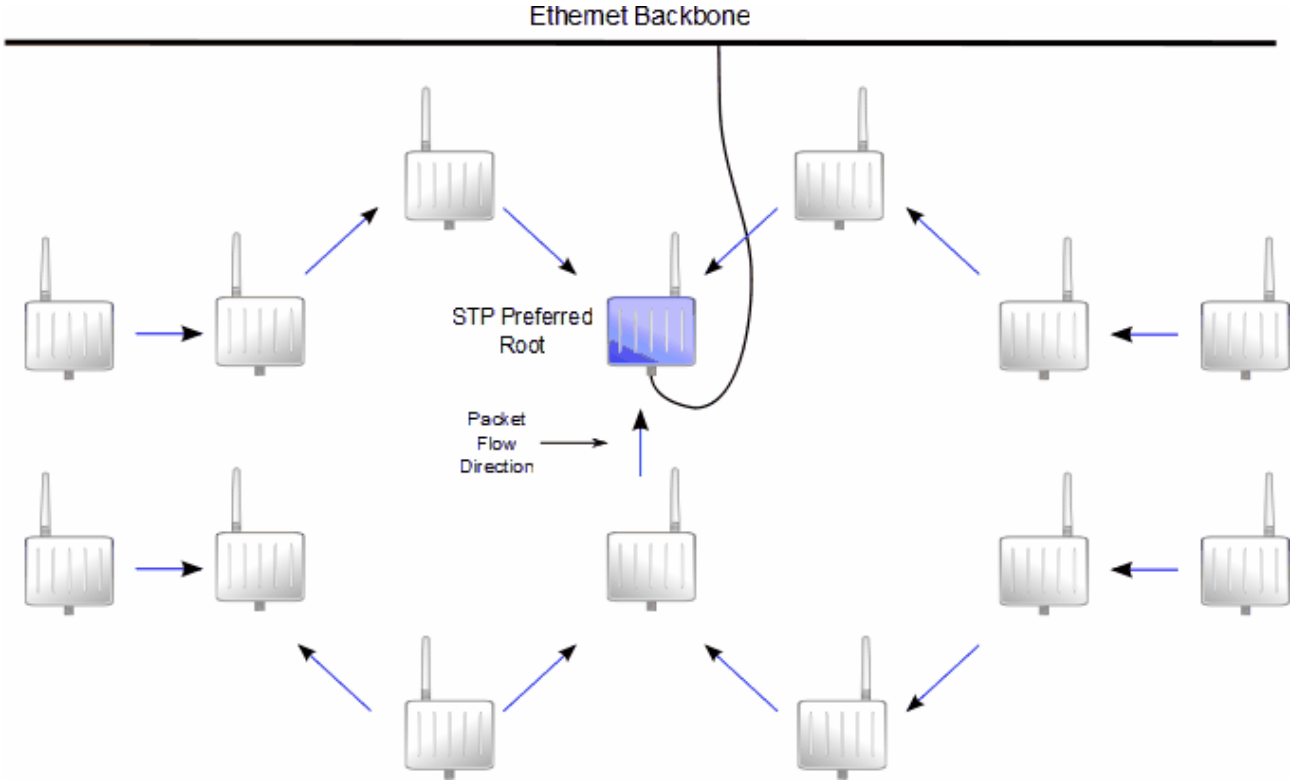
In the second case, choosing a central radio as the STP root will reduce the number of connections between a radio and the STP root. This will normally lead to a more stable network. Note that in such a network, the STP root radio should also be connected to the Ethernet backbone. This setup will provide the most optimal path between the radios and the network operations center.



It is possible to define more than one preferred root radio for the network. In that case, the network will choose the most appropriate of the preferred root radios to use as the STP root. If that radio fails, the network will choose the most appropriate STP root from the remaining preferred root radios.

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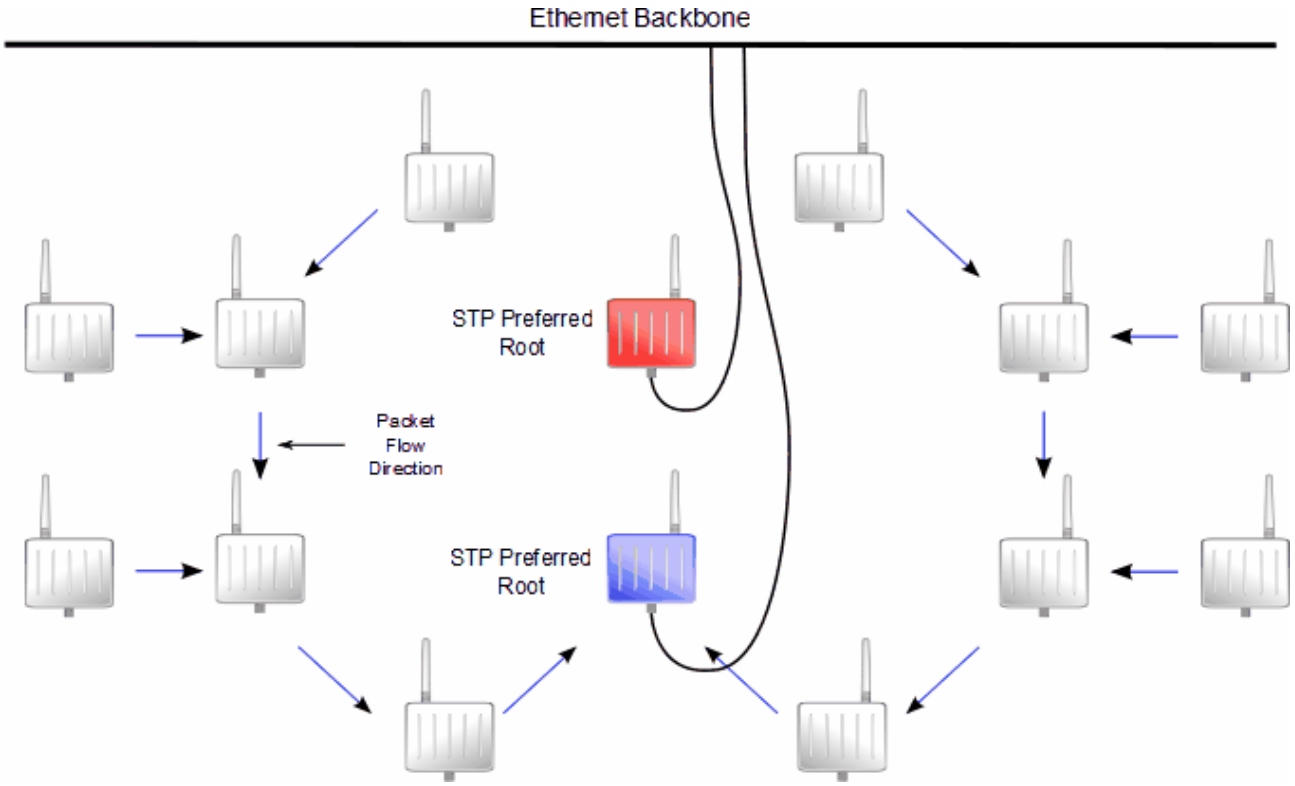
In the following example, two radios are configured as STP root radios. Under normal operation, the top radio (shown in red) would be elected by the network as the STP root radio. Because this radio has failed, the network elects the remaining STP preferred root radio as the actual STP root radio. The traffic is automatically re-routed to the new STP root radio to ensure that all functioning radios can still access the network operations center.



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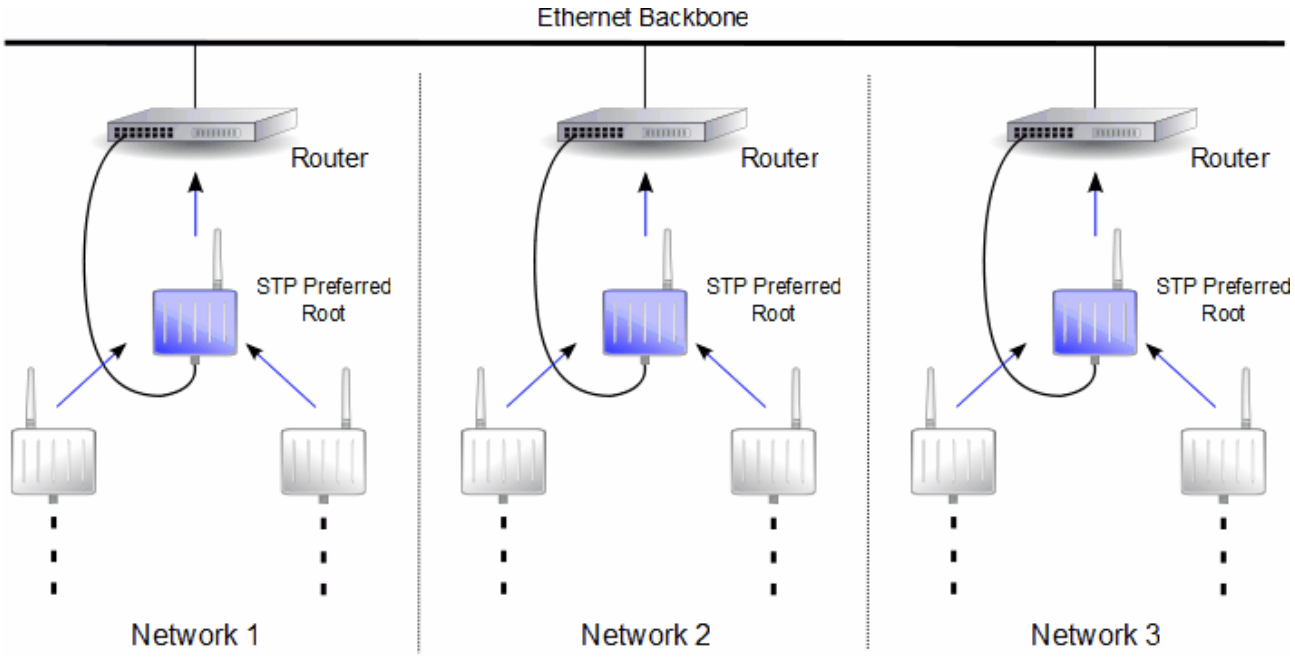
STP / RSTP Network Considerations

STP and RSTP work best when the network contains a limited number of radios. The larger the network, the longer it will take for it to stabilize, and the less stable it will be.

The following guidelines should be followed in order to deploy a trouble-free network:

- Keep the number of radios in the network below 25. If you need to deploy more radios, you should create several, smaller networks that are isolated by routers. Ensure that radios in different networks cannot form WDS connections to each other (e.g. by physically separating the radios and using directional antennas).
- Ensure that there is a maximum of 7 connections separating any two radios in the network.

The following example shows a large network that has been divided into 3 separate segments. In this example, each segment is connected to the Ethernet backbone via a router. The router prevents STP control traffic in one segment from interfering with the other segments. Depending on the capabilities of your router, it would be possible to use a single router, and to configure it so that each of its Ethernet ports block the STP control traffic between segments. Specific information regarding the configuration of the routers is beyond the scope of this document.



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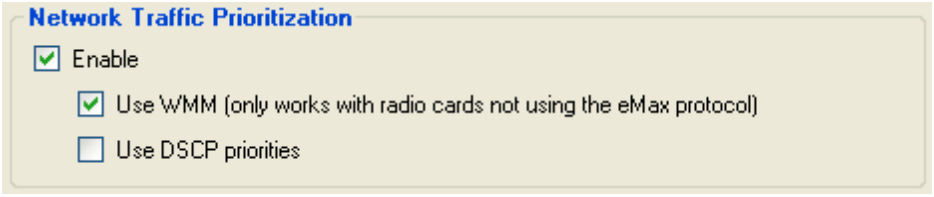
Appendix D: Quality of Service (QoS)

The Quality of Service (QoS) settings allow you to prioritize network traffic so that important traffic is processed ahead of less important traffic.

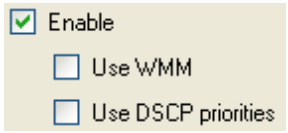
Under normal circumstances, QoS will not perceptibly affect the behavior of the radio. If the radio becomes heavily loaded, and is no longer able to handle all of the network traffic that is flowing through it, the QoS features will automatically start discarding packets associated with the lower priority traffic in order to maintain the integrity of the high priority traffic. Without QoS, all packets would have the same probability of being discarded, regardless of their importance.

> **NOTE** Although the QoS features will help alleviate issues caused by heavy network traffic, they are not a substitute for proper network capacity planning. If you find that your network is constantly congested, you should look at partitioning the network into smaller segments, adding extra radios to provide more capacity, or replacing existing radios with higher capacity radios.

ENCOM Radios support several QoS options, as shown in the following screenshot of the radio configuration form's QoS tab:


Network Traffic Prioritization
Enable
Use WMM (only works with radio cards not using the eMax protocol)
Use DSCP priorities

The options are described in the following table.

QoS Type	Description
None 	If you leave the **Enable** option unchecked, no QoS features are enabled. The network traffic will not be prioritized. Under high load conditions, all packets have the same probability of being discarded, regardless of their importance. This can lead to difficulties managing the radio with ENCOM STRATOS, drop-outs in video and audio streams and generally poor response.
Priority Queues 	If you check the **Enable** option, priority queue based QoS features are enabled. When priority queues are enabled, 8 priority queues are used to manage the network traffic. Each queue is assigned a distinct priority level, in the range of 0 to 7 (where 0 is the lowest priority and 7 is the highest priority). Data packets flowing through the radio are assigned to the appropriate queues based on priority rules. When the radio becomes heavily loaded,

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	the packets in the lower priority queues will be dropped before the traffic in the higher priority queues. Higher priority traffic will be maintained at the expense of the lower priority traffic. ENCOM radio management traffic is always assigned to the highest priority queue. This ensures that ENCOM STRATOS can always access the radio in a timely fashion. Other types of network traffic can be assigned to specific priority queues by creating custom priority rules. Any remaining traffic is assigned to the lowest priority queue. In order to apply priority queue based QoS to the entire network, each radio in the network must be configured with the same priority rules.
Use WMM 	When this option is enabled, priorities are automatically assigned to incoming packets based on their Wi-Fi Multimedia (WMM) priority. If VLANs are being used, packet priorities are automatically assigned from the VLAN priority of incoming packets. Priority queues are still used to manage the packets, and to ensure that the higher priority traffic is maintained at the expense of the lower priority traffic. WMM is a prioritization scheme that is optimized for multimedia applications, such as Voice over IP (VoIP), video streaming and other applications that require low-latency and high-throughput. Even if the radio is not heavily loaded, WMM can improve the quality of audio and video streams by lessening the effect of (potentially bursty) lower priority traffic. The following table shows the type of traffic that is normally assigned to the WMM priorities:

Priority	Traffic Type
0,3	Traffic from devices that lack QoS capabilities, or traffic that is less sensitive to latency, but may be affected by long delays.
1,2	Low priority traffic that does not have strict latency or throughput requirements (e.g. file downloads).
4,5	Higher priority traffic. Normally used for video streams (to prevent dropped frames and jittery playback).
6,7	Highest priority. Normally used for VoIP traffic.

DSCP priorities	When this option is enabled, priorities are automatically assigned to

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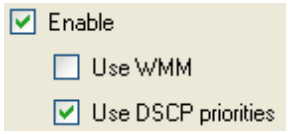
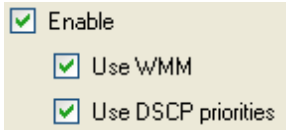
<table>
<tr>
<td> 
</td>
<td>incoming packets based on their DSCP values. Priority queues are still used to manage the packets, and to ensure that the higher priority traffic is maintained at the expense of the lower priority traffic.

The following table shows the priorities that are assigned based for the commonly used DSCP values. As usual, the higher the priority value, the higher the priority.

<table>
<tr><th>DSCP Name</th><th>DSCP Value</th><th>Priority</th></tr>
<tr><td>CS0</td><td>0-7</td><td>0</td></tr>
<tr><td>CS1, AF11, AF12, AF13</td><td>8-15</td><td>1</td></tr>
<tr><td>CS2, AF21, AF22, AF23</td><td>16-23</td><td>2</td></tr>
<tr><td>CS3, AF31, AF32, AF33</td><td>24-31</td><td>3</td></tr>
<tr><td>CS4, AF41, AF42, AF43</td><td>32-39</td><td>4</td></tr>
<tr><td>CS5, EF</td><td>40-47</td><td>5</td></tr>
<tr><td>CS6</td><td>48-55</td><td>6</td></tr>
<tr><td>CS7</td><td>56-63</td><td>7</td></tr>
</table></td>
</tr>
<tr>
<td>Use WMM and DSCP priorities
 
</td>
<td>When both Use WMM and DSCP priorities options are enabled, priorities are automatically assigned to incoming packets based on their DSCP values, and WMM is used to improve the quality of audio and video streams.</td>
</tr>
</table>

Refer to the following topic for a matrix that gives you some basic guidance as to what settings to use for a number of scenarios:

- QoS Recommentation Matrix

Refer to the following topics for detailed QoS examples for various network scenarios:

- Using Priority Queues to Ensure Access to Radios
- Using WMM to Simplify Radio Configuration
- Using WMM to Improve Video Traffic
- Using DSCP to Simplify Radio Configuration

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- Using DSCP and WMM to Improve Video Traffic
- Using WMM to support VLAN Priority Traffic

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QoS Recommendation Matrix

The following table gives you some basic guidance as to what settings to use for a number of network scenarios. Note that this is not an exhaustive list. You may need to analyze your network in order to choose the right options.

QoS Option to use ➡ Requirement ⬇	☑ Enable ☐ Use WMM ☐ Use DSCP priorities	☑ Enable ☑ Use WMM ☐ Use DSCP priorities	☑ Enable ☐ Use WMM ☑ Use DSCP priorities	☑ Enable ☑ Use WMM ☑ Use DSCP priorities
Can be used with eMax	✔		✔	
Must support Wireless-N mode	✔		✔	
Packet priorities must be propagated through Ethernet links			✔	✔
VLAN priorities are used to prioritize traffic		✔		✔
Video and/or VOIP integrity must be maintained		✔		✔

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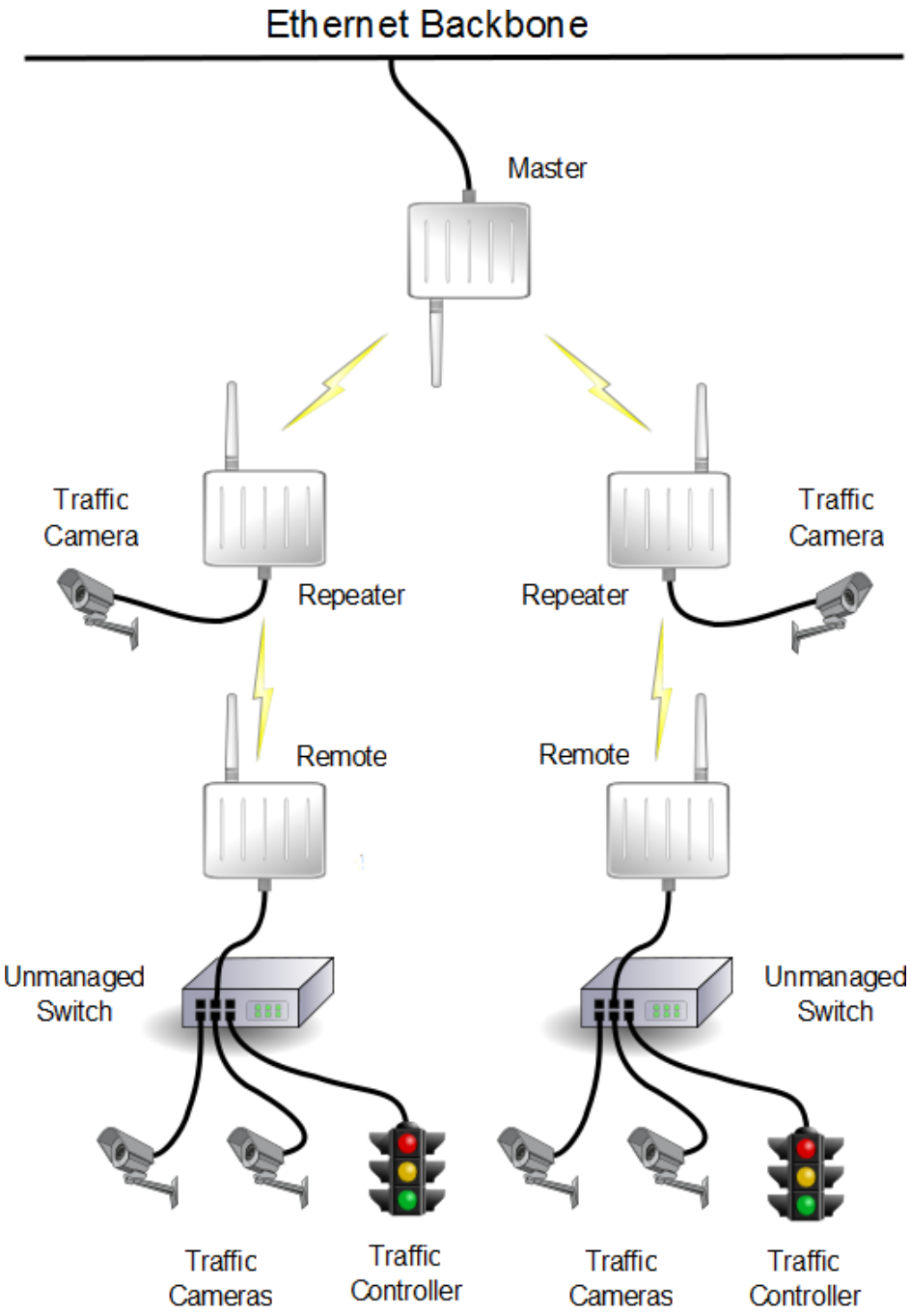
Using Priority Queues to Ensure Access to Radios

The following diagram shows a typical ENCOM broadband network. In this scenario, a large amount of video is being produced by the traffic cameras. The quantity of video traffic is great enough to cause issues with STRATOS, and is causing timeout issues when trying to communicate with the traffic controllers.



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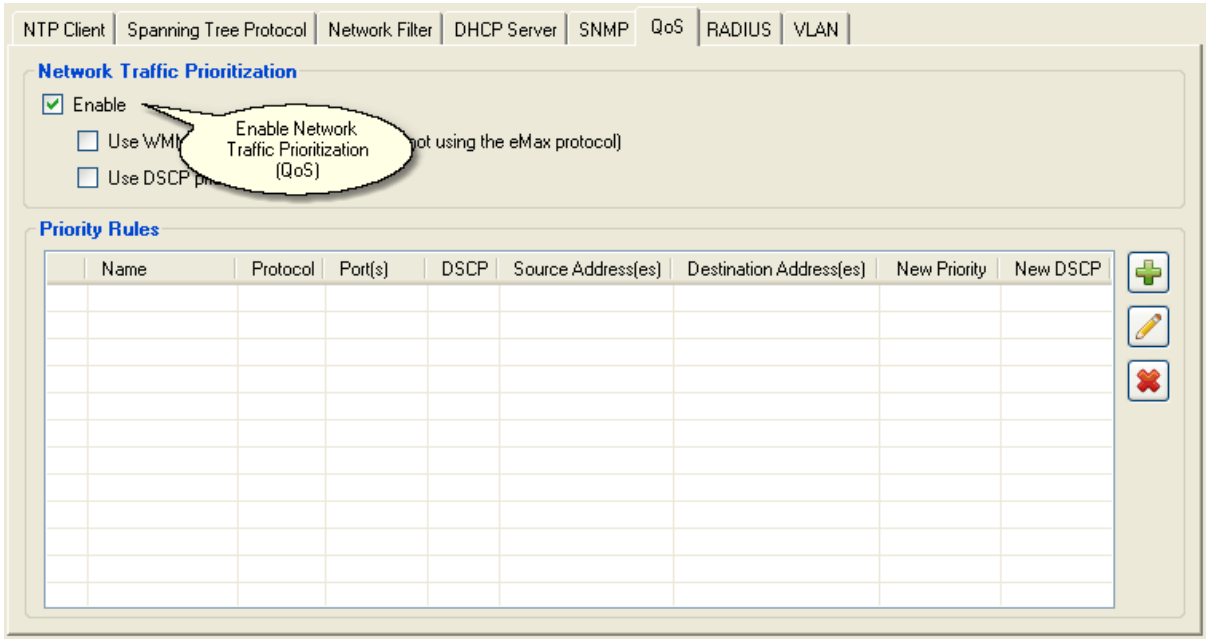
It was decided that the video traffic was less important than timely access to the radios and to the traffic controllers. A priority queue based mechanism was implemented to prevent the video streams from interfering with STRATOS and with the traffic controllers.

Assuming that the network operations center communicates with the traffic controllers on TCP port 6000, you would configure the radios' QoS settings as follows:

1. Enable the **Network Traffic Prioritization** option in the radio configuration form's QoS tab.



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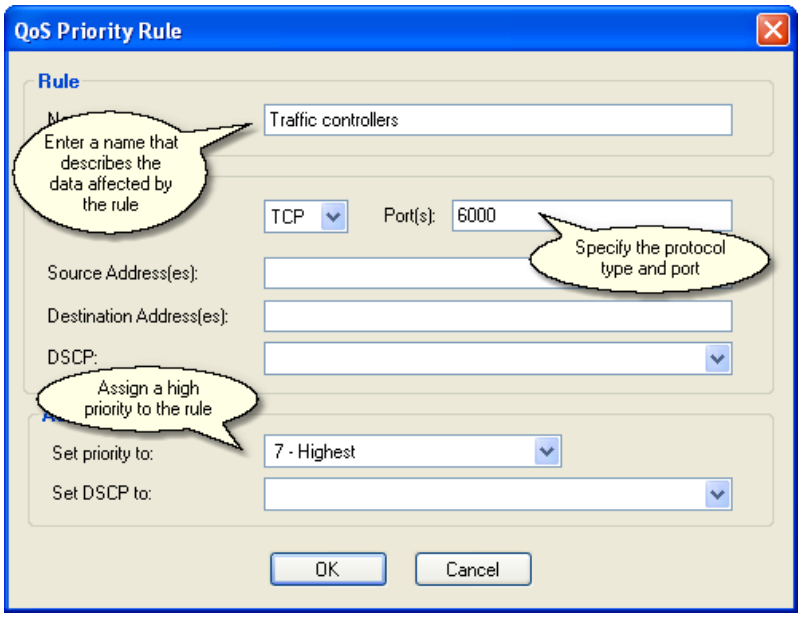
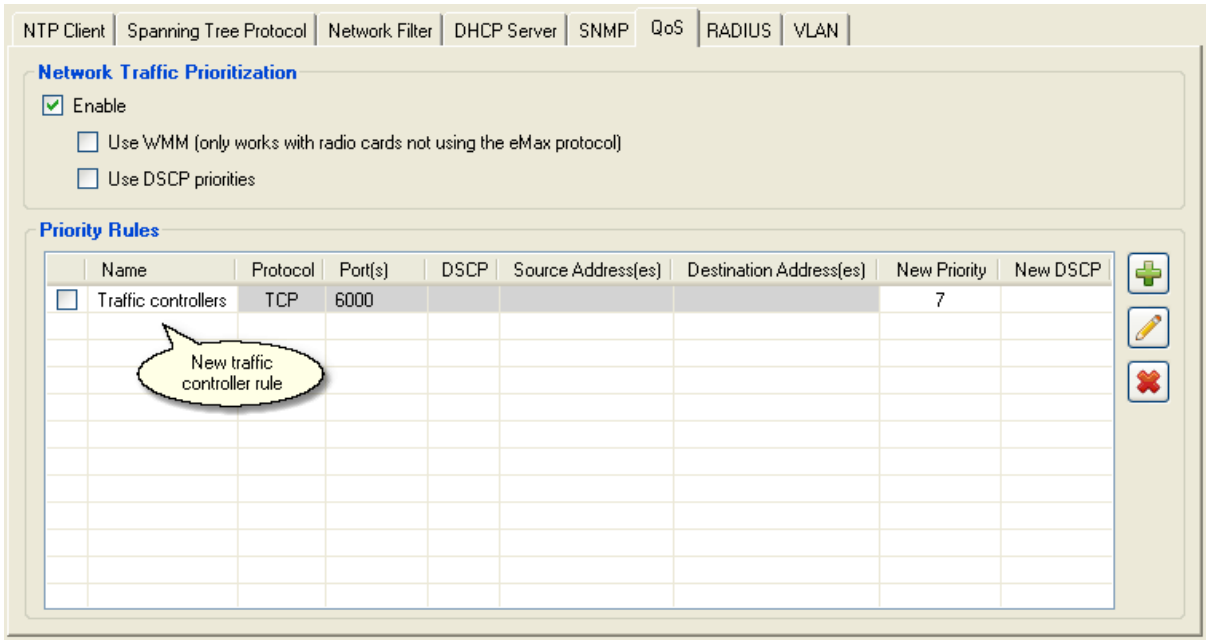
2. Create the traffic controller priority rule. To do this, click on the button at the right of the priority rule list, and enter the following information in the *QoS Priority Rule* form:



3. Press **OK** to create the new rule.



Since STRATOS will automatically assign the highest possible priority to the protocols that it uses to communicate with the radios, you do not need to add any rules for that traffic.

To ensure that the network performs reliably, all of the radios in the network should be provisioned with the same QoS settings.

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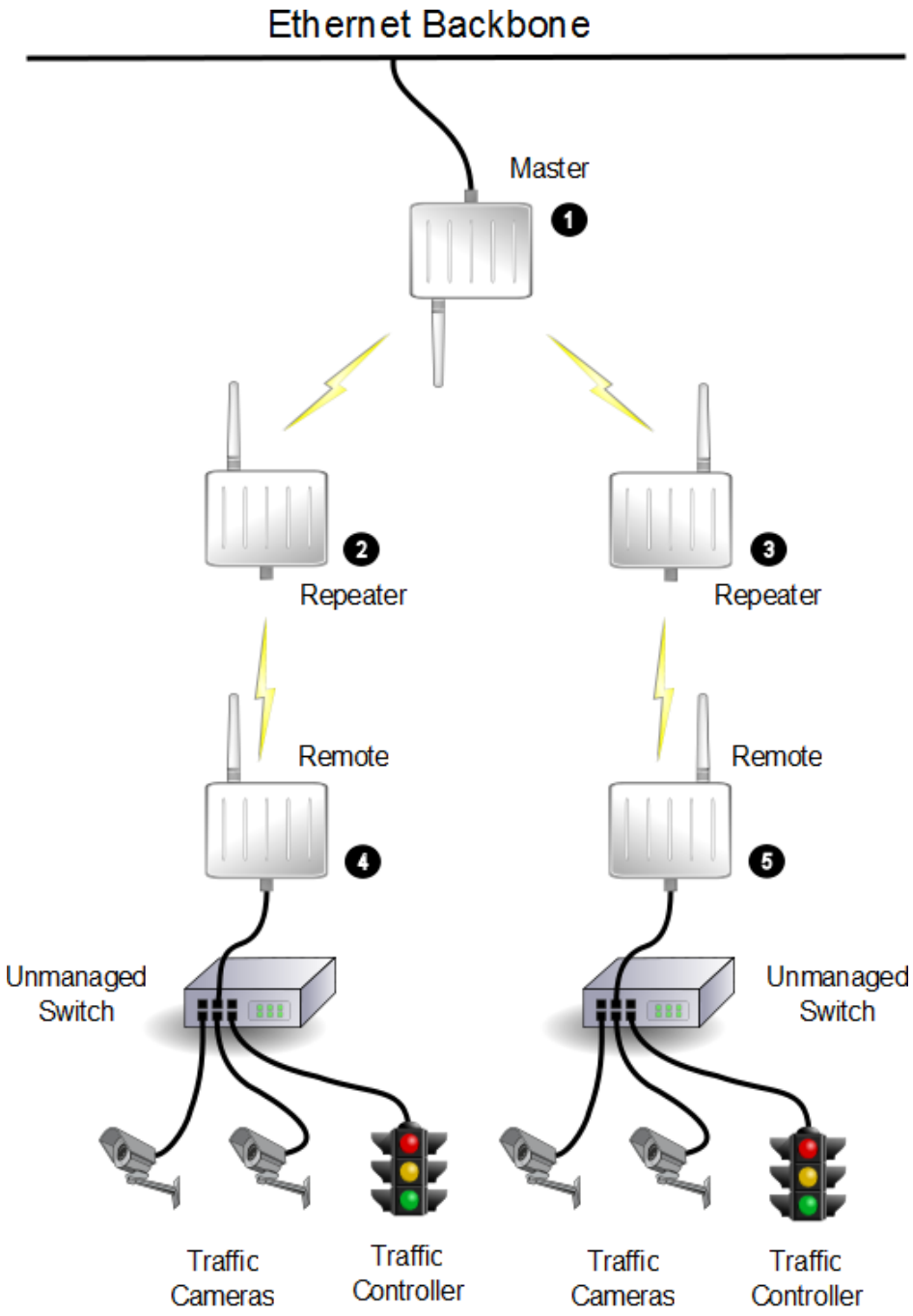
Using WMM to Simplify Radio Configuration

The following diagram shows a simple ENCOM broadband network. In this scenario, a large amount of video is being produced by the traffic cameras. The quantity of video traffic is great enough to cause issues with STRATOS, and is causing timeout issues when trying to communicate with the traffic controllers.



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It was decided that the video traffic was less important than timely access to the radios and to the traffic controllers.

By analyzing the network, it was noted that the repeater radios are only used to transfer network traffic between the network operation center and the devices connected to the remote radios. Because of this, it is possible to use the WMM QoS option to simplify the configuration of the repeater radios.

The QoS configuration settings for each of the 5 radios are described in the following topics:

- Master and Remote Radio Configuration
- Repeater Radio Configuration

NOTE

Because WMM is not compatible with the eMax protocol, you must disable eMax in the wireless radio cards (and lose the throughput enhancements available when eMax is enabled).

If you are using Point-to-Multipoint radios configured for N-Mode operation, you cannot disable eMax, and therefore cannot use WMM. In that case, use the priority queue mechanism to implement QoS.

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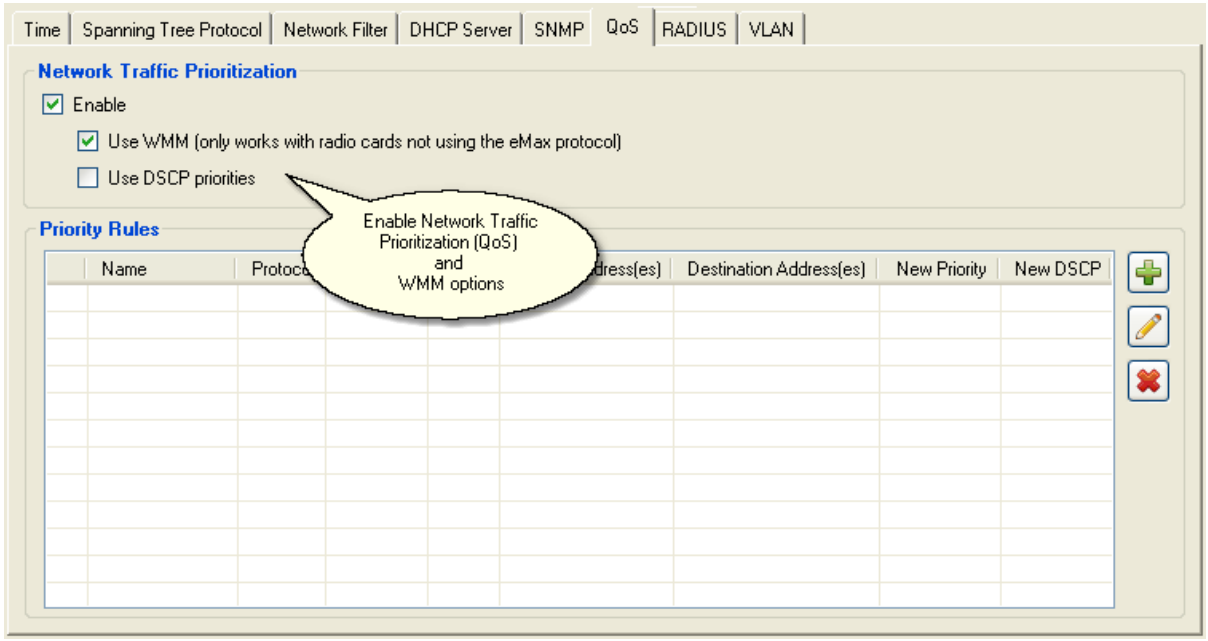
Master and Remote Radio Configuration

Assuming that the network operations center communicates with the traffic controllers on TCP port 6000, you would configure the master and remote radios (radios 1, 4 and 5 in the diagram) as follows:

1. Enable the **Network Traffic Prioritization** and **WMM** options in the radio configuration form's QoS tab.



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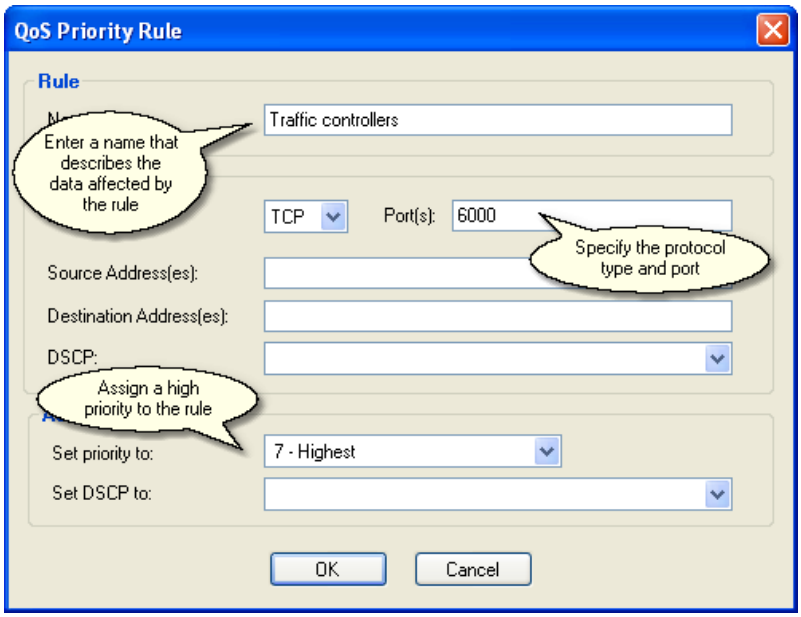
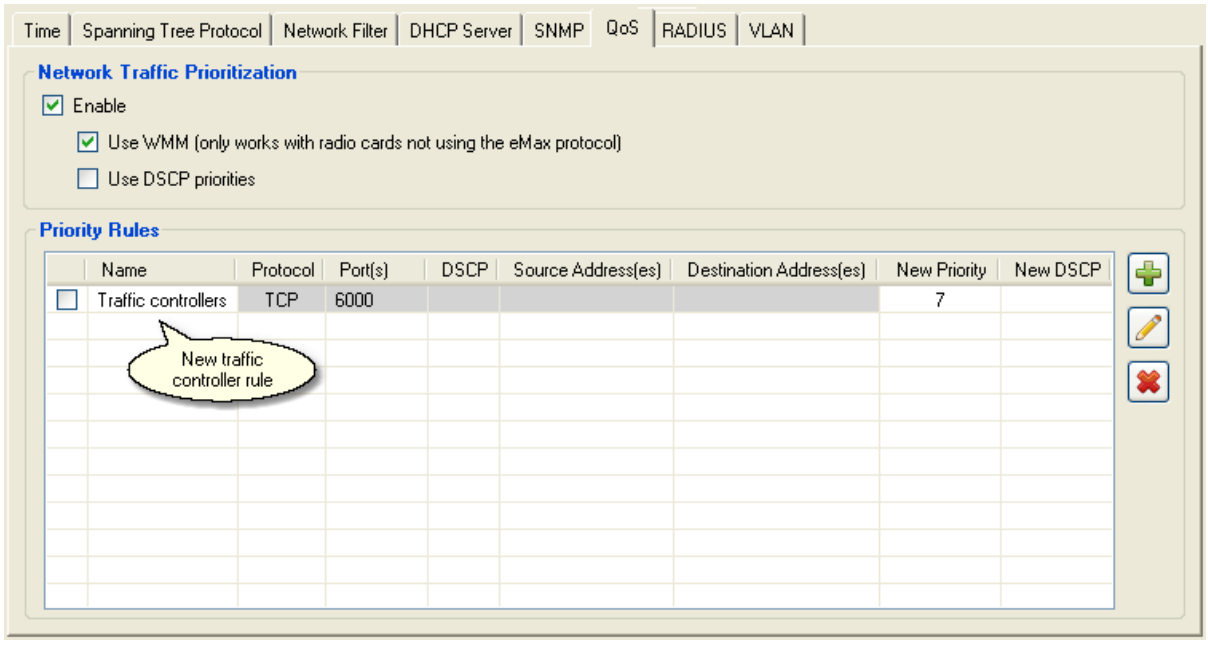
2. Create the traffic controller priority rule. To do this, click on the button at the right of the priority rule list, and enter the following information in the *QoS Priority Rule* form:



3. Press **OK** to create the new rule.



Note that STRATOS will automatically assign the highest possible priority to the protocols that it uses to communicate with the radios. You do not need to add any rules for this traffic.

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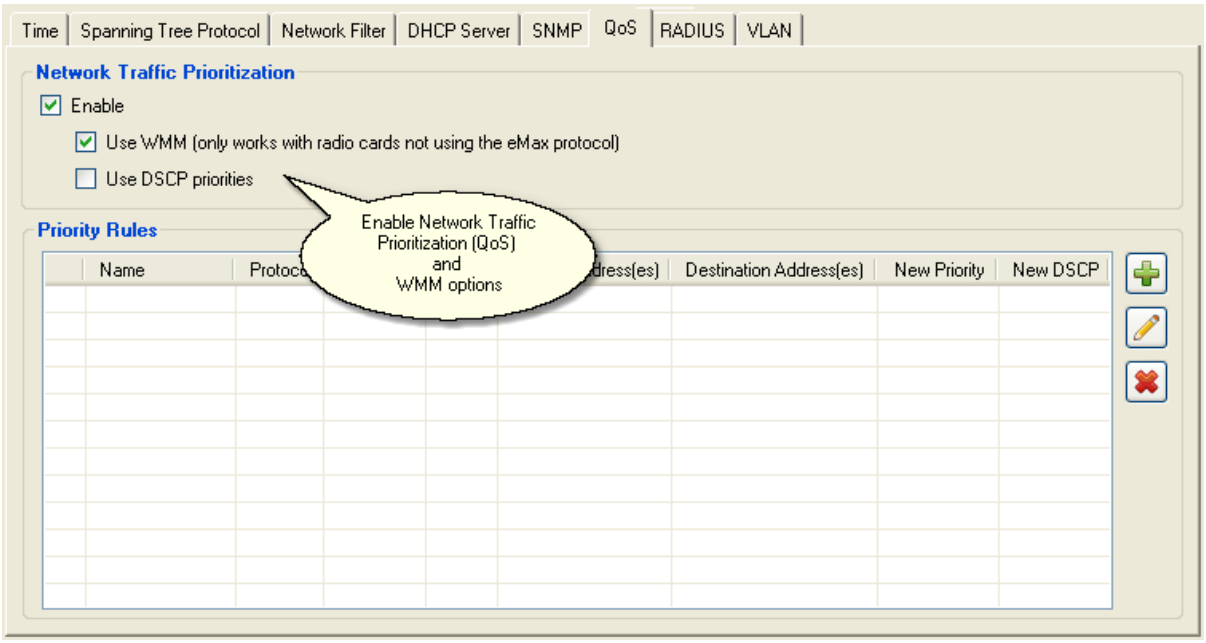
Repeater Radio Configuration

The repeater radios (radios 2 and 3 in the diagram) would be configured as follows:



When WMM is enabled, the repeater radios will automatically prioritize the packets received on their wireless interfaces.There is no reason to specify the custom traffic rules.

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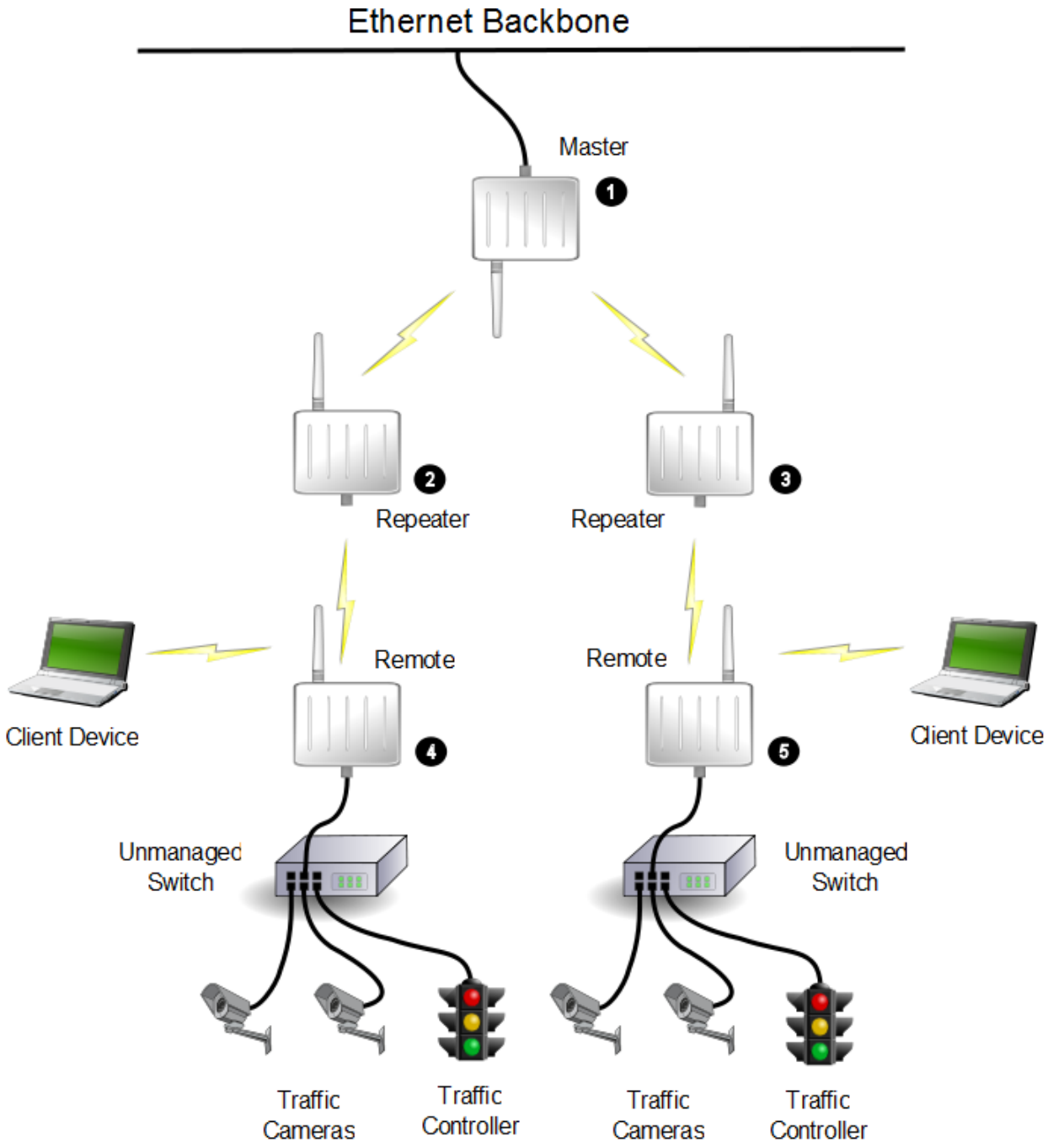
Using WMM to Improve Video Traffic

The following diagram shows a slightly more complex ENCOM broadband network. In this scenario, the radio network carries video and traffic controller data, as well as client device data (in this case, from laptops used by field personnel).



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Under normal operation, the network is not excessively loaded. However, when several users were accessing the network with their laptops, it was noted that the network performance degraded, and the video feeds suffered from dropped frames and jerky behavior.

In order to prevent the laptop traffic from impacting the more important video and controller traffic, it was decided use the WMM prioritization scheme. This scheme allows the video and traffic controller protocols to be given higher priority, and has the added benefit of optimizing the video streams.

By analyzing the network, it was also noted that the repeater radios are only used to transfer network traffic between the network operation center and the devices connected to the remote radios. Because of this, it is also possible to use the WMM QoS option to simplify the configuration of the repeater radios.

The QoS configuration settings for each of the 5 radios, are described in the following topics:

- Master and Remote Radio Configuration
- Repeater Radio Configuration

NOTE

Because WMM is not compatible with the eMax protocol, you must disable eMax in the wireless radio cards (and lose the throughput enhancements available when eMax is enabled).

If you are using Point-to-Multipoint radios configured for N-Mode operation, you cannot disable eMax, and therefore cannot use WMM. In that case, use the priority queue mechanism to implement QoS.

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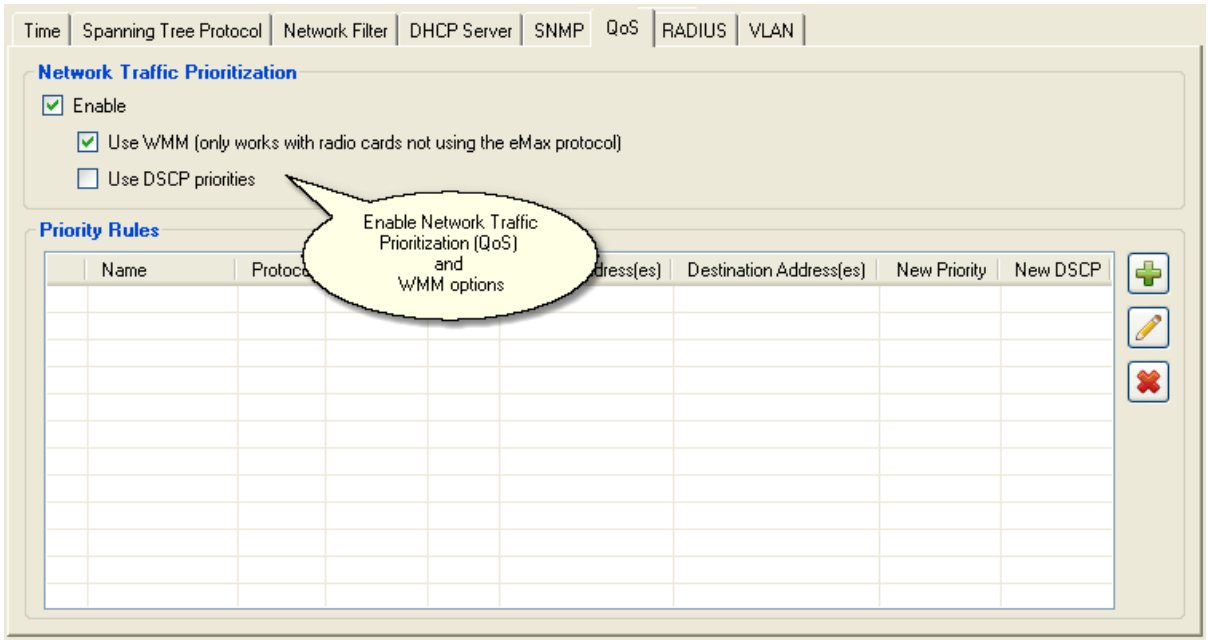
Master and Remote Radio Configuration

For this example, assume that:

- The network operations center communicates with the traffic controllers on TCP port 6000.
- The video cameras stream video on UDP port 5000.

The master and remote radios (radios 1, 4 and 5 in the diagram) would be configured as follows:

1. Enable the **Network Traffic Prioritization** and **WMM** options in the radio configuration form's QoS tab.



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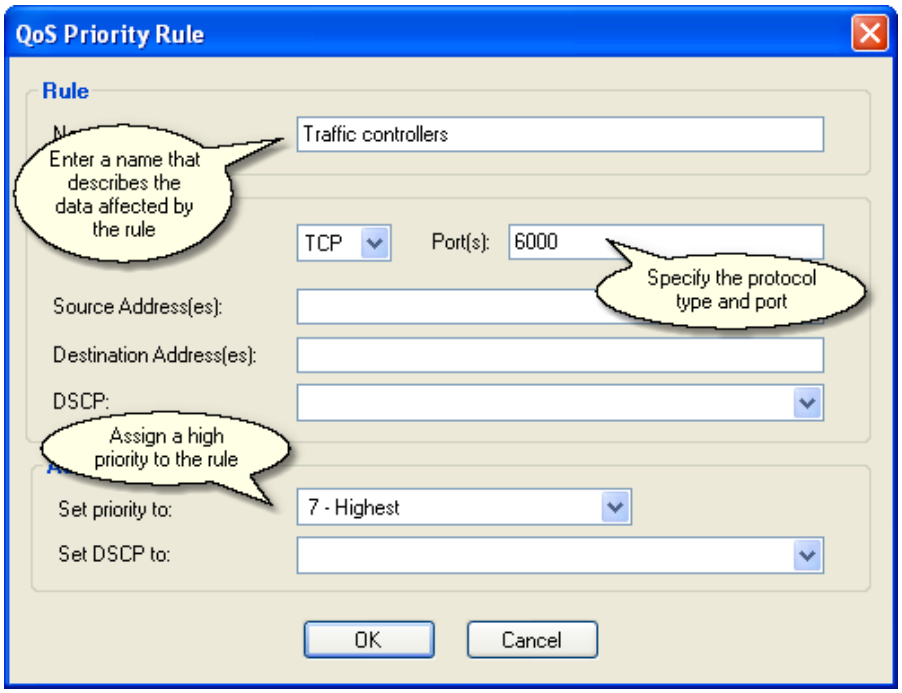
2. Create the traffic controller priority rule. To do this, click on the button at the right of the priority rule list, and enter the following information in the *QoS Priority Rule* form:



3. Press **OK** to create the new rule.

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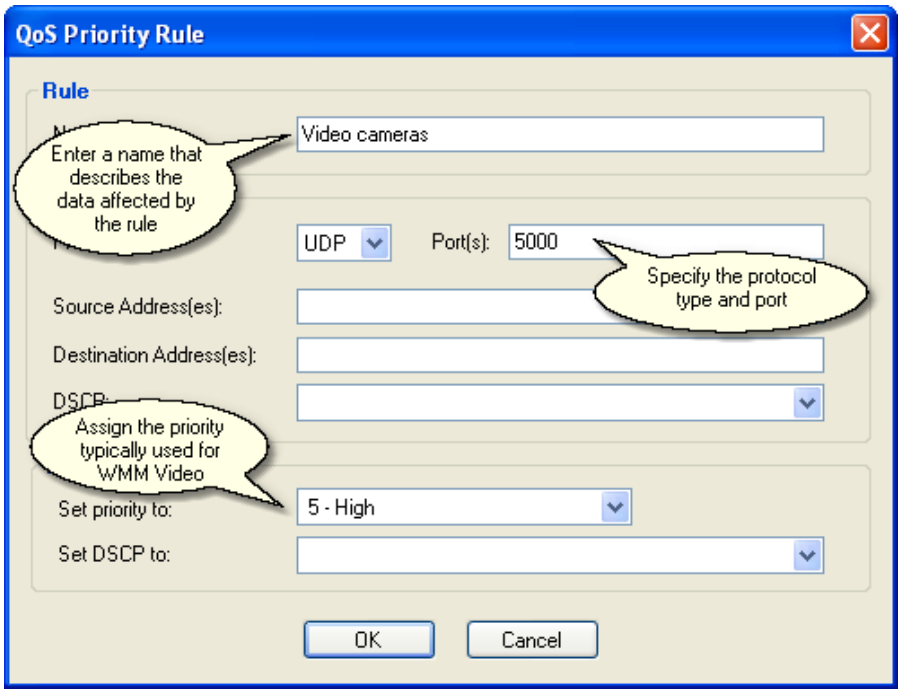
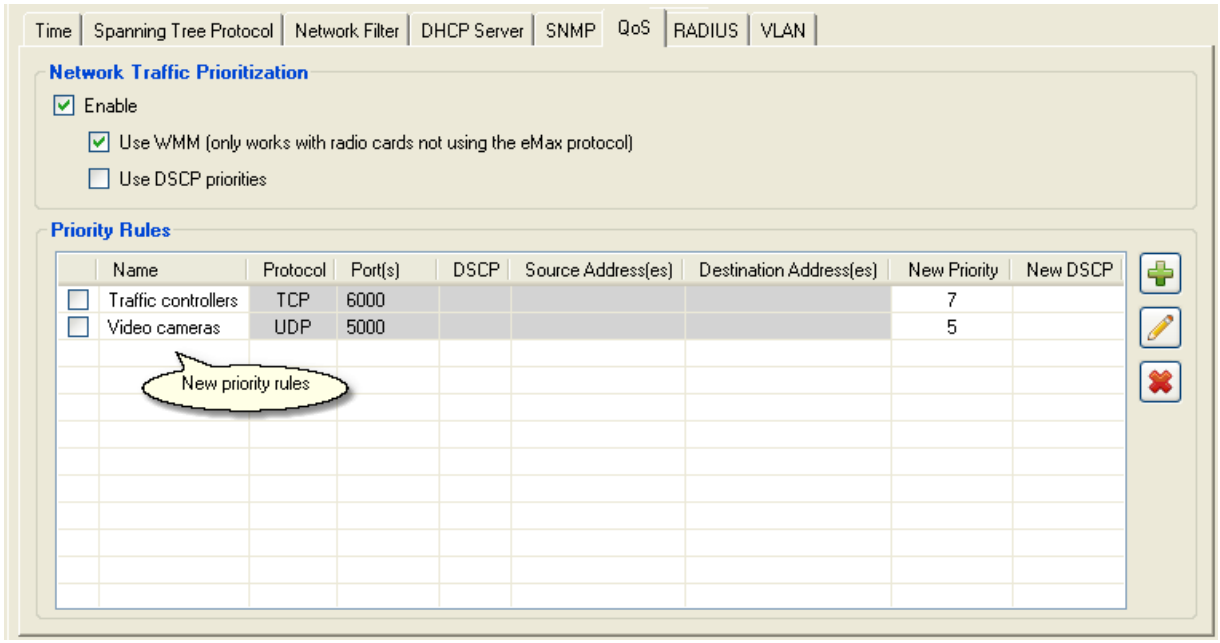
4. Create the video camera priority rule. To do this, click on the button at the right of the priority rule list, and enter the following information in the *QoS Priority Rule* form:



5. Press **OK** to create the new rule.



Note that STRATOS will automatically assign the highest possible priority to the protocols that it uses to communicate with the radios. You do not need to add any rules for this traffic.

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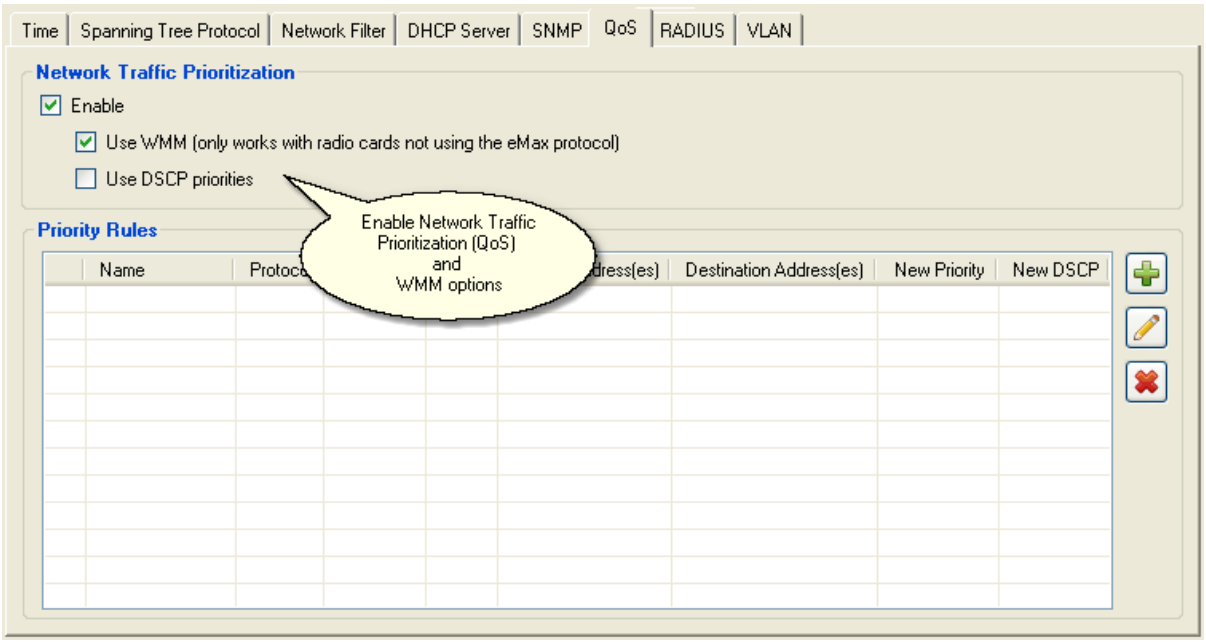
Repeater Radio Configuration

The repeater radios (radios 2 and 3 in the diagram) would be configured as follows:



When WMM is enabled, the repeater radios will automatically prioritize the packets received on their wireless interfaces.There is no reason to specify the custom traffic rules.

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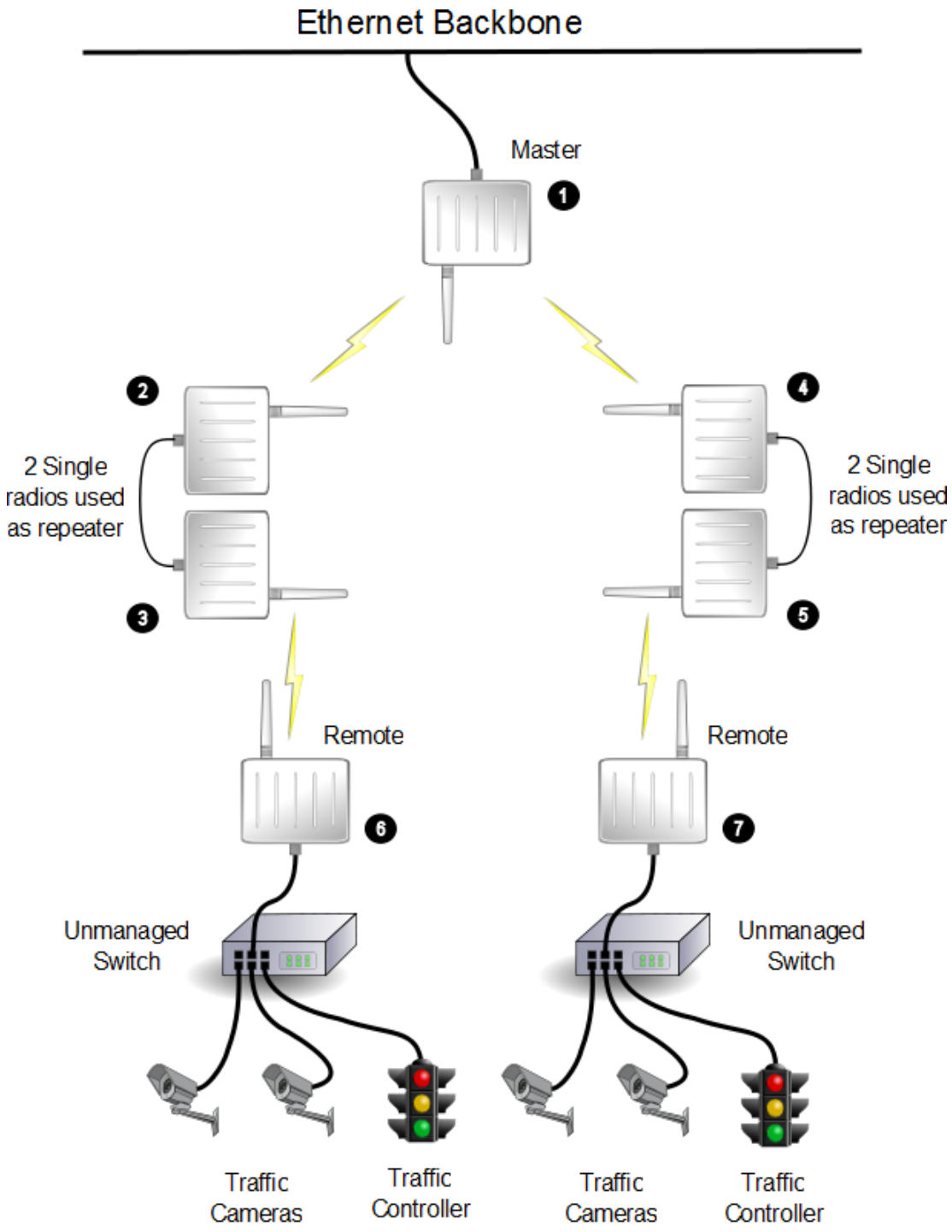
Using DSCP to Simplify Radio Configuration

The following diagram shows a slightly more complex ENCOM broadband network. In this scenario, the radio network carries video and traffic controller data, as well as client device data (in this case, from laptops used by field personnel).



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By analyzing the network, it was noted that the repeater radios are only used to transfer network traffic between the network operation center and the devices connected to the remote radios.

For performance reasons, pairs of single radios connected via their Ethernet ports are used as repeaters. WMM is problematic in this scenario since the WMM priorities are lost when the data packets pass through the Ethernet link. To address this issue, DSCP priorities can be used to simplify the configuration of the repeater radios.

The QoS configuration settings for each of the 7 radios, are described in the following topics:

- Master and Remote Radio Configuration
- Repeater Radio Configuration

NOTE DSCP can only be used with IP-based traffic. If the protocol used to communicate with remote devices is not based on the IP-based protocols, use the priority queue mechanism to implement QoS.

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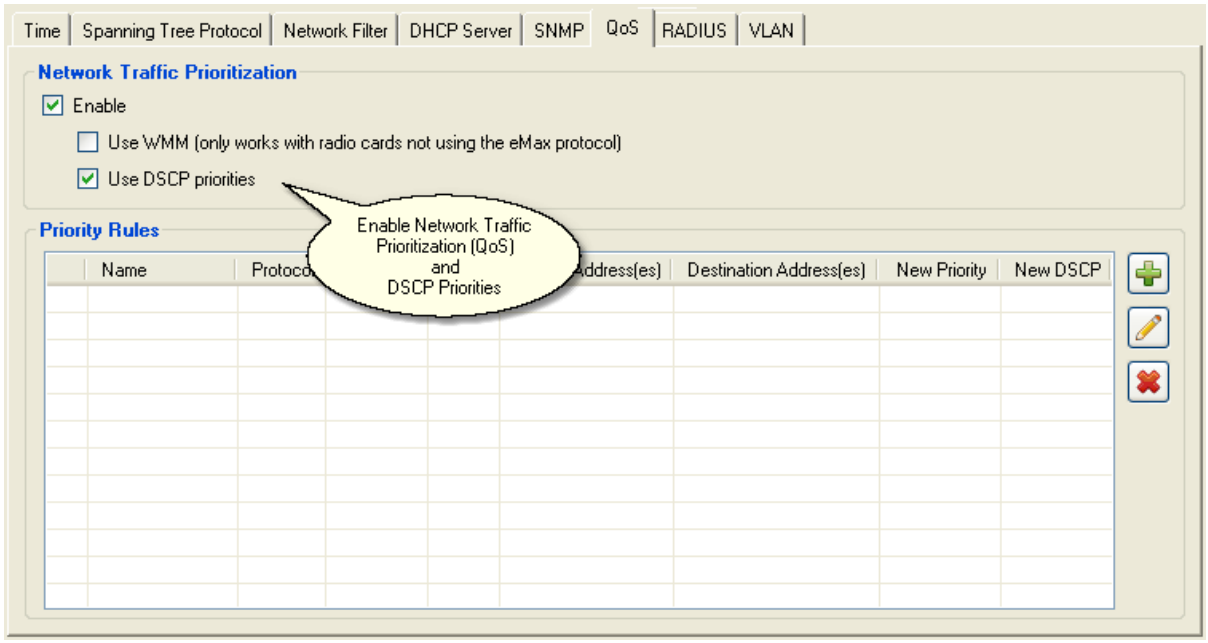
Master and Remote Radio Configuration

For this example, assume that:

- The network operations center communicates with the traffic controllers on TCP port 6000.
- The video cameras stream video on UDP port 5000.

The master and remote radios (radios 1, 4 and 5 in the diagram) would be configured as follows:

1. Enable the **Network Traffic Prioritization** and **DSCP priorities** options in the radio configuration form's QoS tab.



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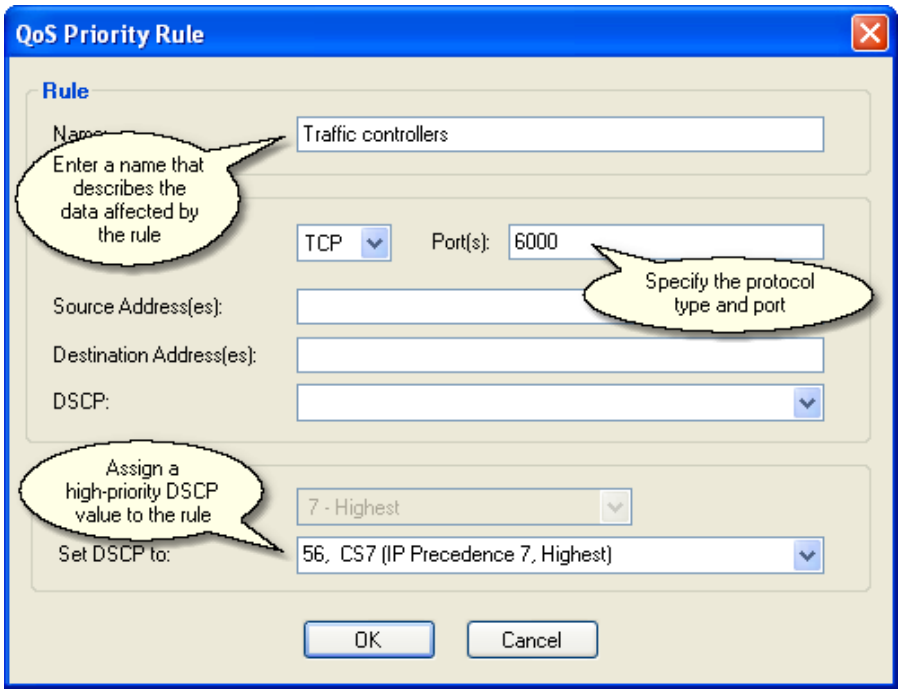
2. Create the traffic controller priority rule. To do this, click on the button at the right of the priority rule list, and enter the following information in the *QoS Priority Rule* form:



3. Press **OK** to create the new rule.

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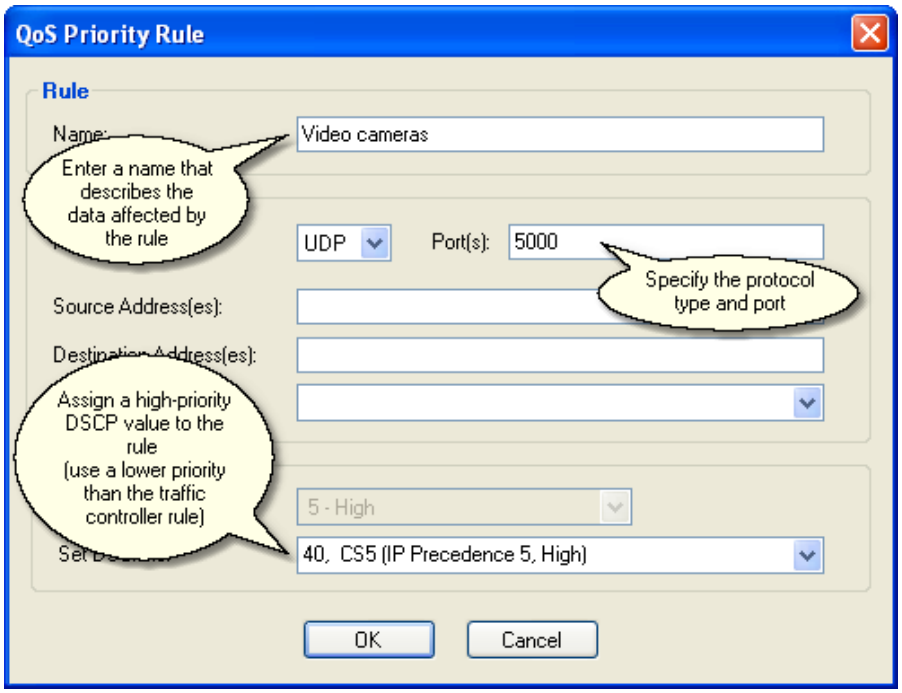
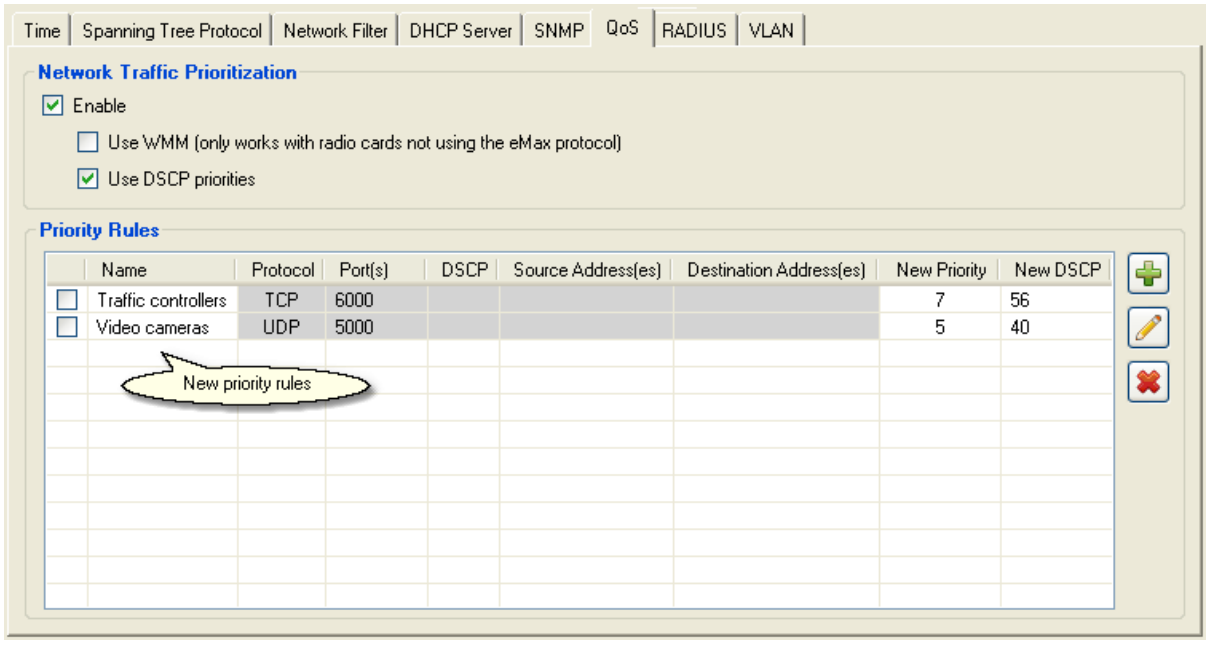
4. Create the video camera priority rule. To do this, click on the button at the right of the priority rule list, and enter the following information in the *QoS Priority Rule* form:



5. Press **OK** to create the new rule.



Note that STRATOS will automatically assign the highest possible priority to the protocols that it uses to communicate with the radios. You do not need to add any rules for this traffic.

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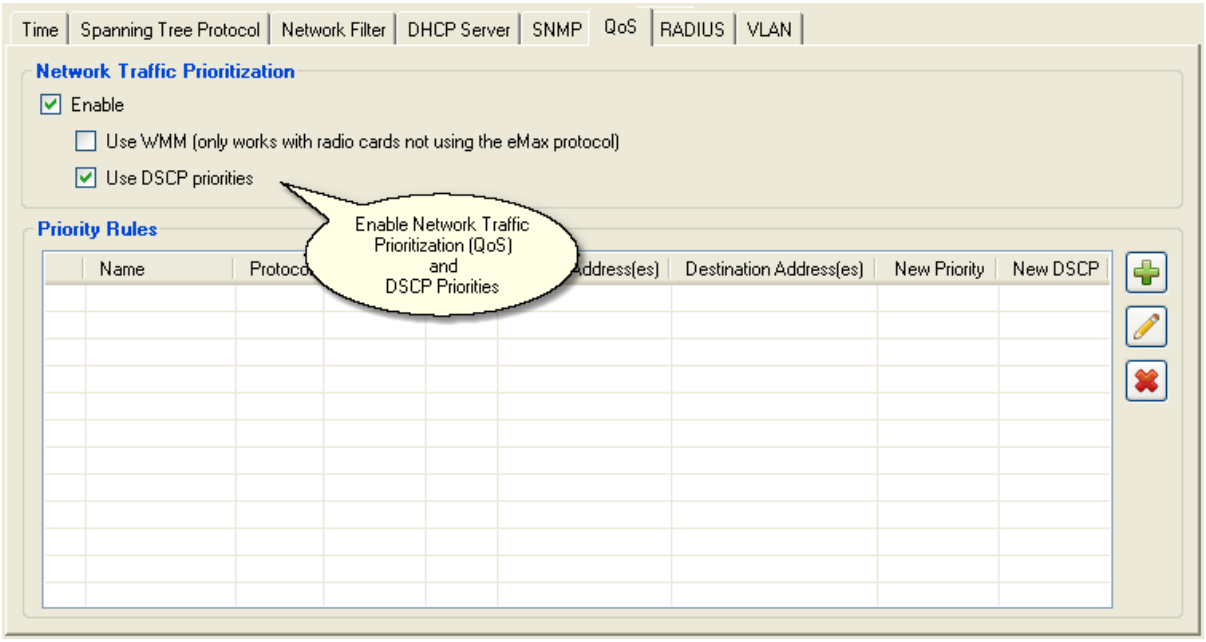
Repeater Radio Configuration

The repeater radios (radios 2 and 3 in the diagram) would be configured as follows:



When DSCP priorities are enabled, the repeater radios will automatically prioritize received packets based on their DSCP values.There is no reason to specify the custom traffic rules.

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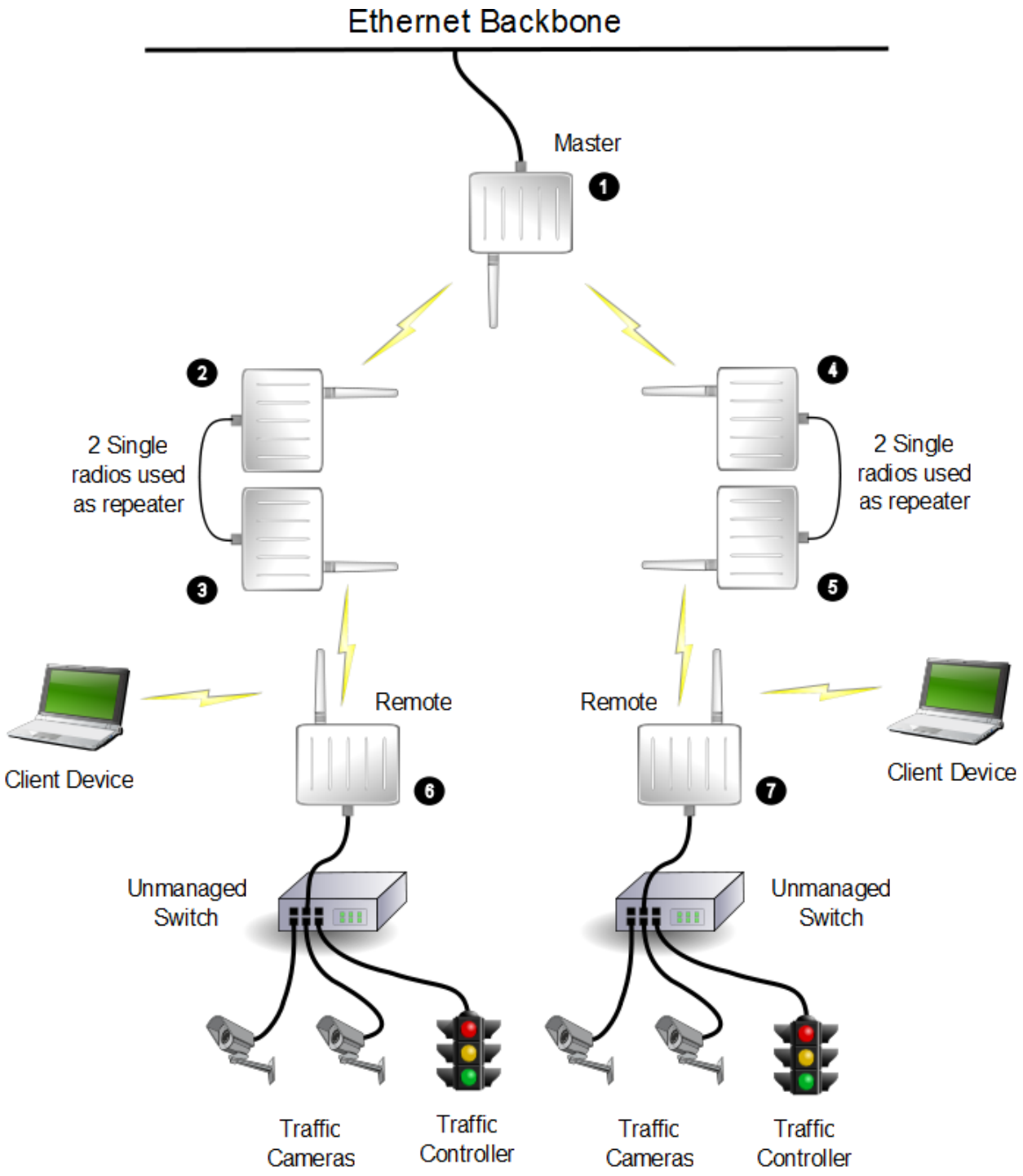
Using DSCP and WMM to Improve Video Traffic

The following diagram shows a slightly more complex ENCOM broadband network. In this scenario, the radio network carries video and traffic controller data, as well as client device data (in this case, from laptops used by field personnel).



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Under normal operation, the network is not excessively loaded. However, when several users were accessing the network with their laptops, it was noted that the network performance degraded, and the video feeds suffered from dropped frames and jerky behavior.

In order to prevent the laptop traffic from impacting the more important video and controller traffic, it was desired to use the WMM prioritization scheme. Unfortunately, WMM priorities are lost when the data packets pass trough the Ethernet link. To address this issue, DSCP priorities were used to ensure that the packet priorities were preserved across the Ethernet link. WMM prioritization was enabled as well to further enhance the quality of the video stream.

The QoS configuration settings for each of the 7 radios, are described in the following topics:

- Master and Remote Radio Configuration
- Repeater Radio Configuration

NOTE DSCP can only be used with IP-based traffic. If the protocol used to communicate with remote devices is not based on the IP-based protocols, use the priority queue mechanism to implement QoS.

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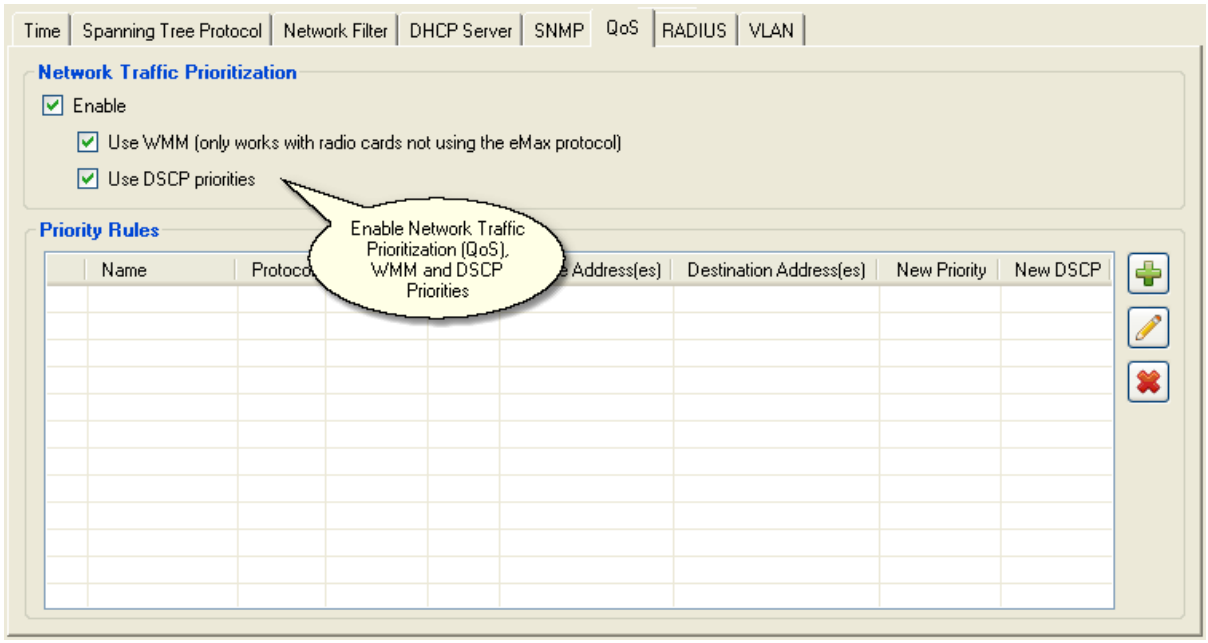
Master and Remote Radio Configuration

For this example, assume that:

- The network operations center communicates with the traffic controllers on TCP port 6000.
- The video cameras stream video on UDP port 5000.

The master and remote radios (radios 1, 4 and 5 in the diagram) would be configured as follows:

1. Enable the **Network Traffic Prioritization**, **WMM**, and **DSCP priorities** options in the radio configuration form's QoS tab.



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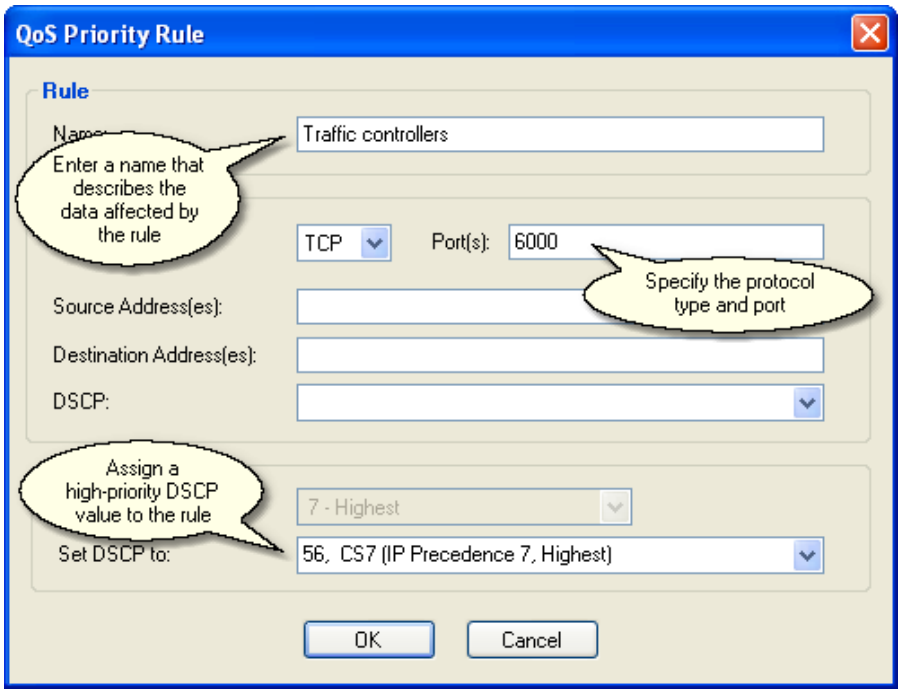
2. Create the traffic controller priority rule. To do this, click on the button at the right of the priority rule list, and enter the following information in the *QoS Priority Rule* form:



3. Press **OK** to create the new rule.

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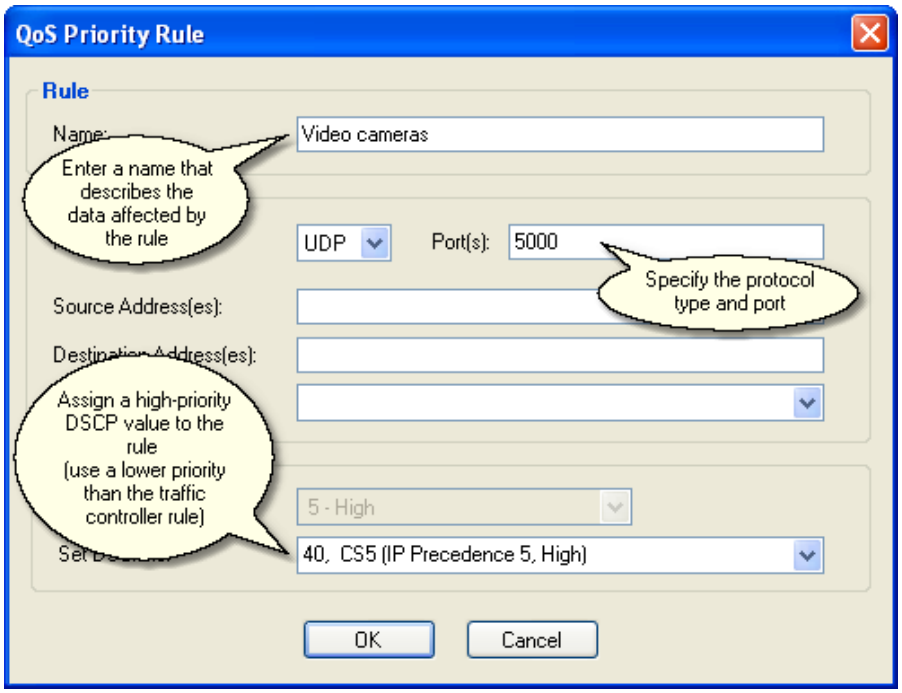
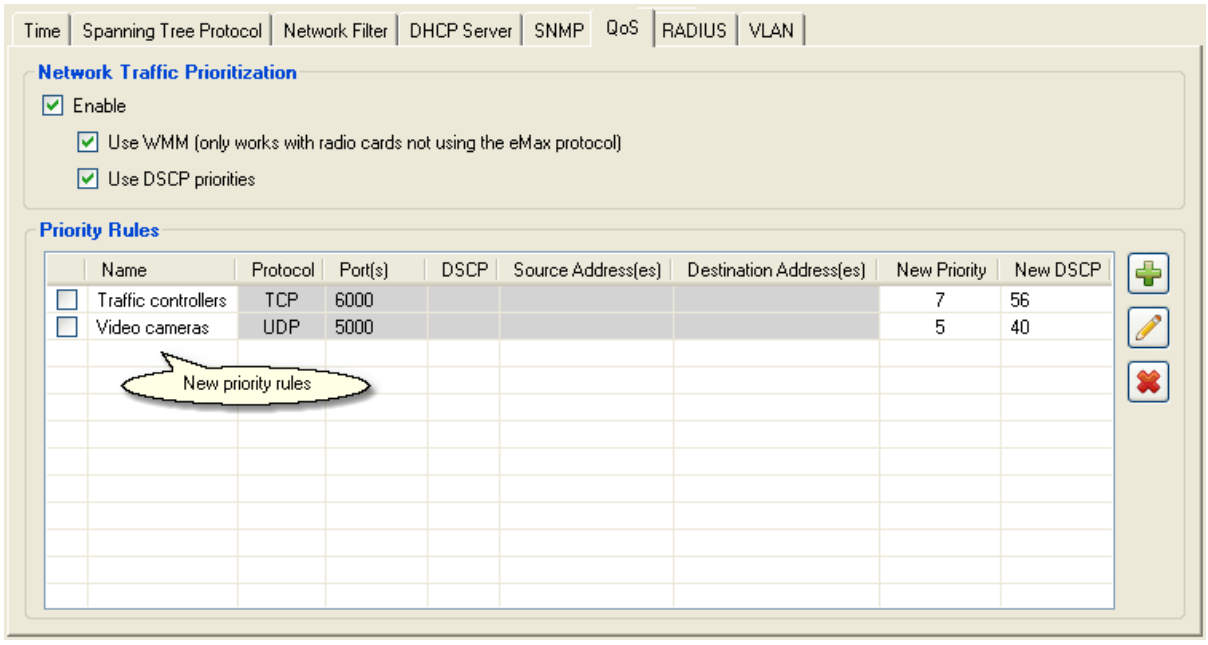
4. Create the video camera priority rule. To do this, click on the button at the right of the priority rule list, and enter the following information in the *QoS Priority Rule* form:



5. Press **OK** to create the new rule.



Note that STRATOS will automatically assign the highest possible priority to the protocols that it uses to communicate with the radios. You do not need to add any rules for this traffic.

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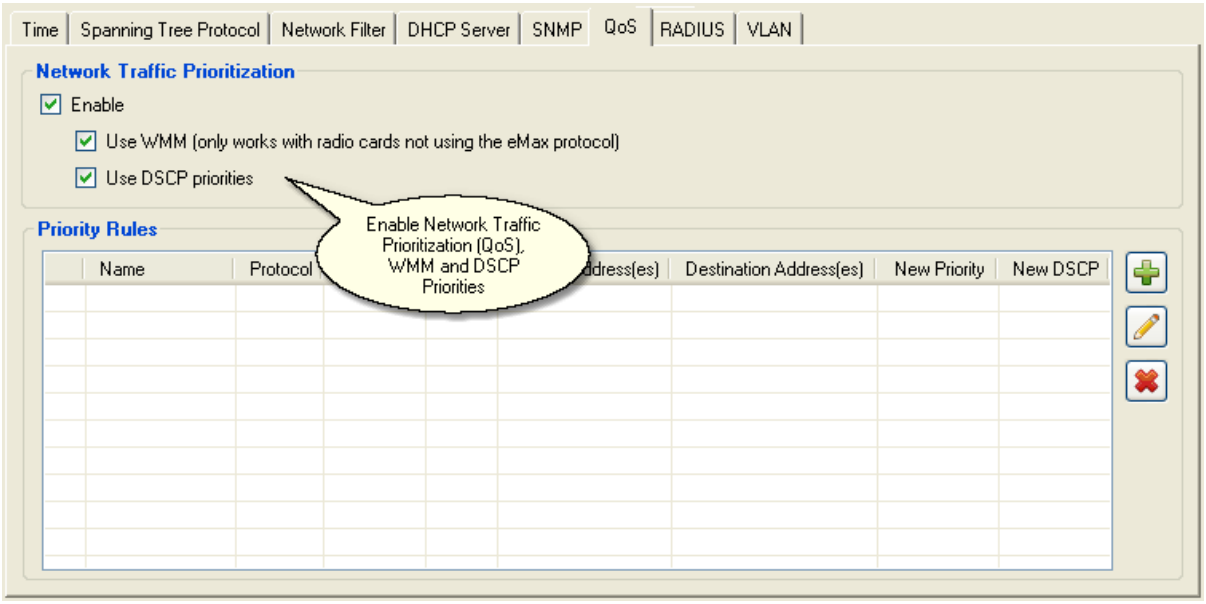
Repeater Radio Configuration

The repeater radios (radios 2 and 3 in the diagram) would be configured as follows:



When DSCP priorities are enabled, the repeater radios will automatically prioritize received packets based on their DSCP values. WMM will further enhance the quality of the video stream. There is no reason to specify the custom traffic rules.

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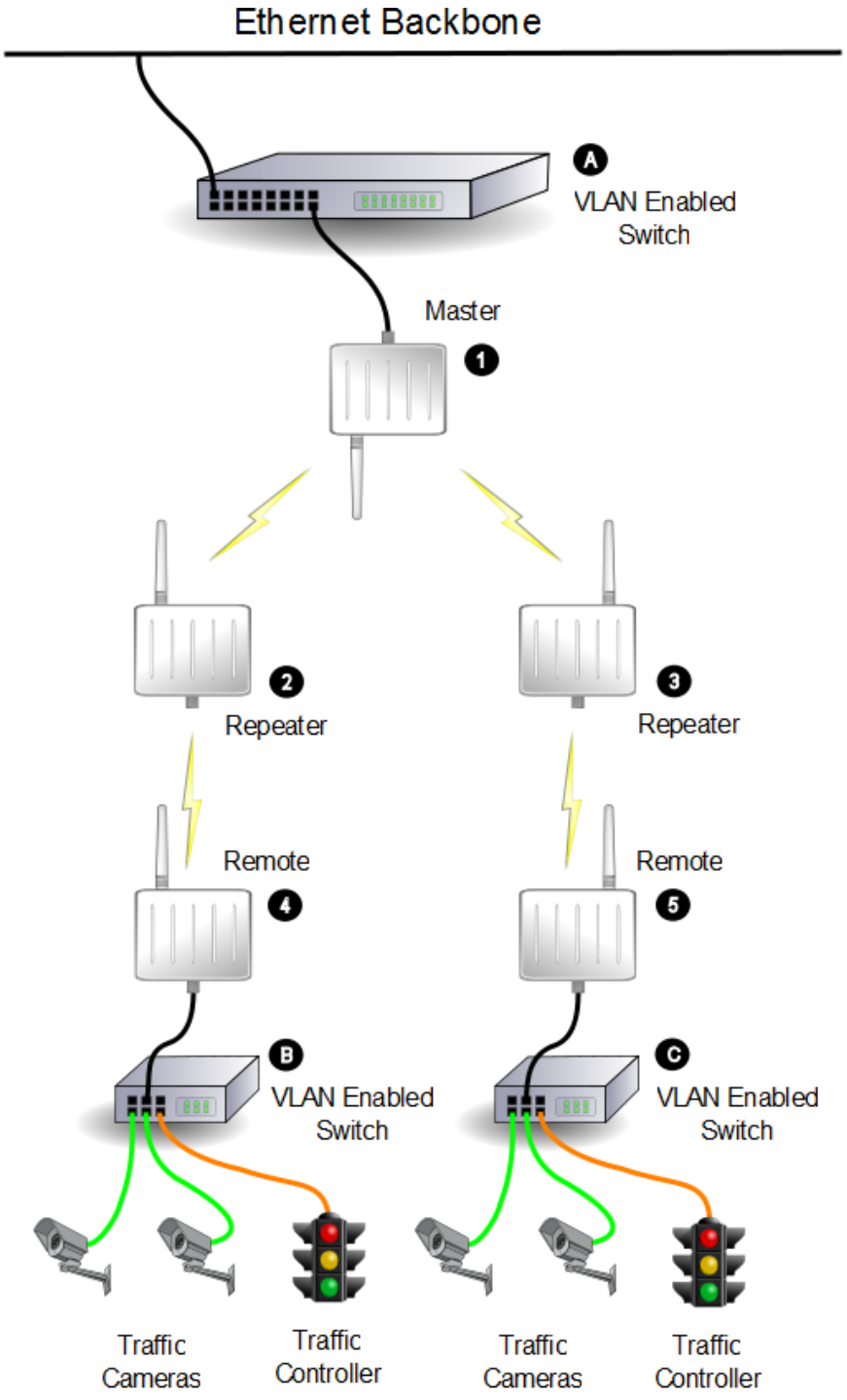
Using WMM to Support VLAN Priority Traffic

The following diagram shows an ENCOM broadband network where VLANs are being used to segregate the management, traffic controller and video camera network traffic. The quantity of video traffic is great enough to cause issues with STRATOS, and is causing timeout issues when trying to communicate with the traffic controllers.



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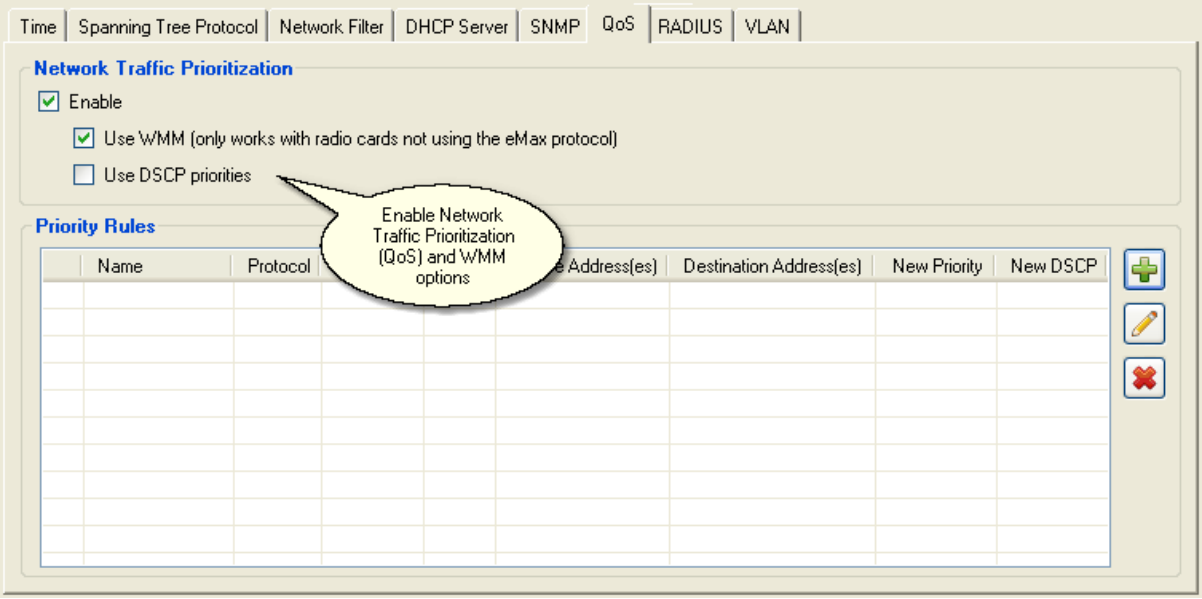
It was decided that the video traffic was less important than timely access to the radios and to the traffic controllers. Because VLANs are already being used to segregate the various types of network traffic, they can also be used to prioritize the traffic. To do this, the VLAN enabled switches (A, B and C in the diagram) would be configured to give the appropriate priorities to the camera and controller traffic:

Network Traffic Type	VLAN Priority
Traffic Controller	7 (highest priority)
Traffic Cameras	5 (high priority)

The WMM prioritization mechanism would be used to prioritize the network traffic over the wireless links (to ensure that the high priority traffic controller packets are sent at the expense of the lower priority camera traffic).

Each of the 5 radios in the network would be configured as follows:



For more information on the VLAN capabilities of ENCOM radios, refer to Appendix E: VLAN Support.

NOTE

Because WMM is not compatible with the eMax protocol, you must disable eMax in the wireless radio cards (and lose the throughput enhancements available when eMax is enabled).

If you are using Point-to-Multipoint radios configured for N-Mode operation, you cannot disable eMax, and therefore cannot use WMM. In that case, use the priority queue mechanism to implement QoS.

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Appendix E: VLAN Support

Short for "Virtual LAN", a VLAN is a network of computers, servers and other network devices that behave as if they are connected to the same wire, even though they may be physically located on different LAN segments. A LAN segment is a section of the local area network that is used by a particular workgroup or department, and that is separated from the rest of the LAN by a router or switch.

Multiple VLANs can coexist on the same physical network, but the devices that are part of a particular VLAN are invisible to the devices in other VLANs. This behavior can help increase network security by reducing the number of devices that have access to each other. A compromise in one VLAN would not affect the resources in the other VLANs.

VLANs can also improve the performance of the network. VLANs can be used to restrict the dissemination of broadcast and device-to-device traffic between network segments. Network traffic associated with a particular VLAN will not be forwarded by the switch or router to other network segments that are associated with other VLANs.

VLAN Components

The following table describes the most common items associated with VLANs.

Term	Description
Access Port	The Ethernet port on a switch, router, or ENCOM radio that provides a connection for network devices (workstations, cameras, traffic controllers, etc.).
Trunk Port	The Ethernet port on a switch, router, or ENCOM radio that carries traffic from more than one VLAN.
Tagging	The process of adding the VLAN ID to a network data packet's Ethernet header.
VLAN ID	A number used to identify a specific VLAN.
Native VLAN	The VLAN for which the tagging process is not performed. The native VLAN typically has a VLAN ID of 1.
Default VLAN	The VLAN assigned to an Ethernet port by default. The default VLAN is typically the native VLAN.
Management VLAN	The VLAN used to manage the switch, router or radio. This VLAN is assigned an IP address so that the device can be accessed using the appropriate management tools.

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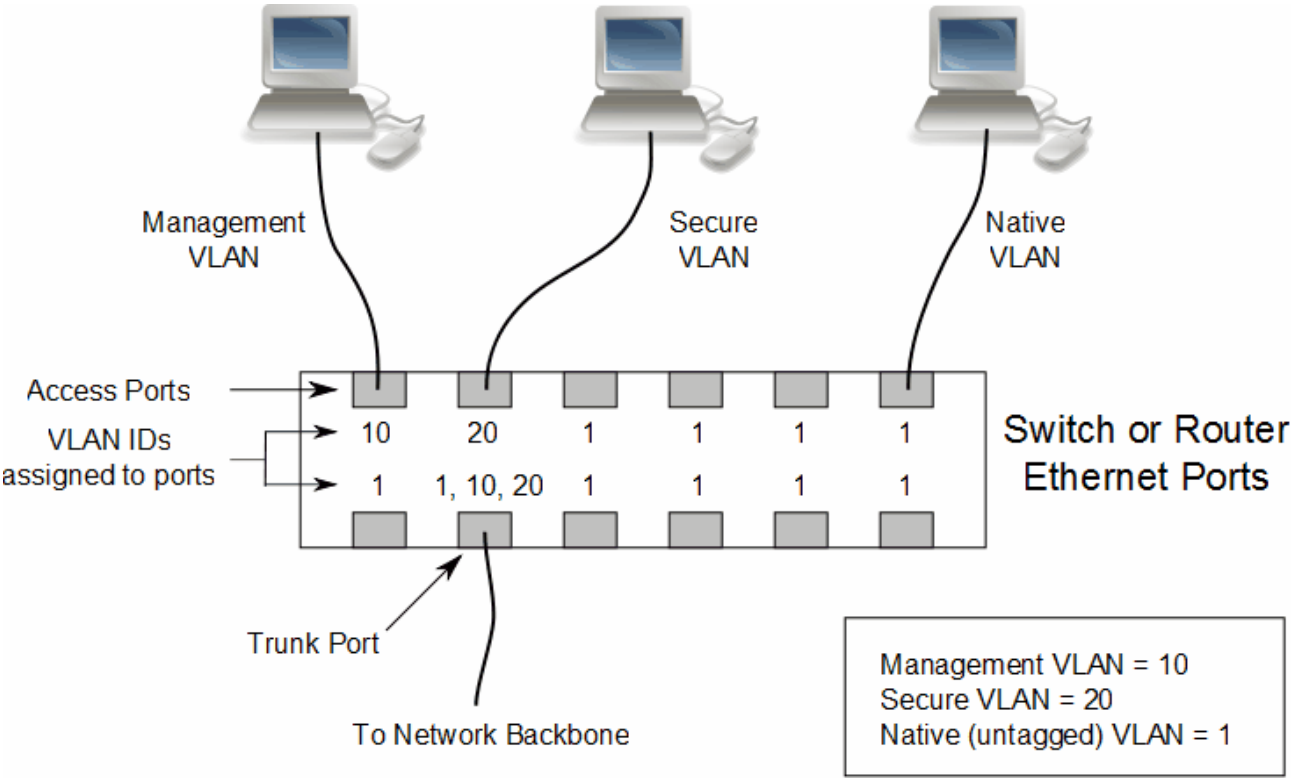
The following diagram shows the relationships between these items:



In the example, two VLANs have been defined and assigned to the appropriate access ports:

- Management VLAN (ID = 10)
- Secure VLAN (ID = 20)

The management VLAN is used to isolate the workstations that are used to view and change the configuration settings of the switches, routers and radios that are part of the network infrastructure.

The Secure VLAN is used to isolate the workstations that access sensitive resources (both the workstations and the sensitive resources would be connected to the Secure VLAN).

The Native VLAN is used by non-secured workstations to access the non-sensitive network resources.

Access to the company network is provided by the trunk port that routes all of the tagged and untagged VLAN traffic onto the corporate LAN.

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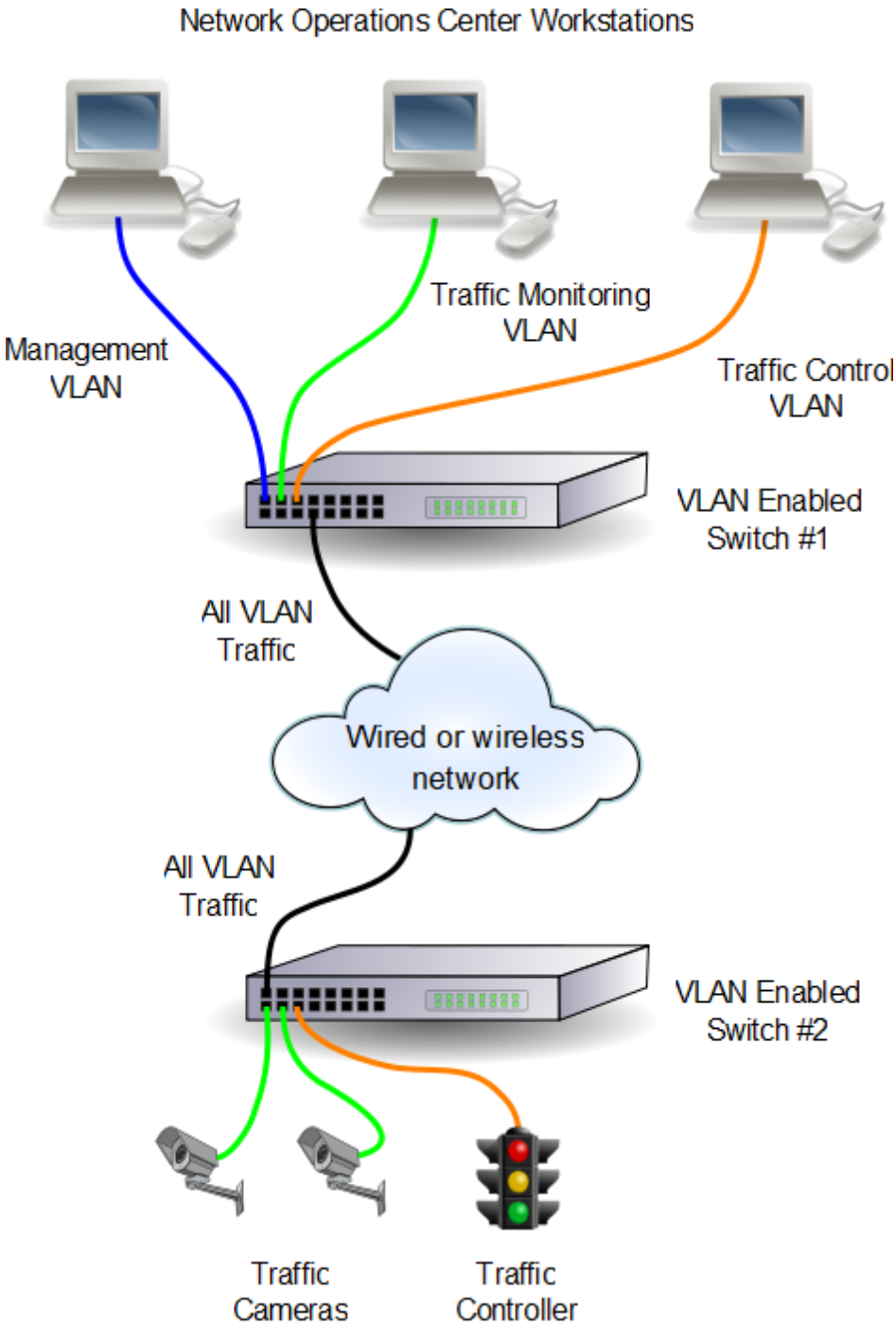
Example VLAN Setup

The following diagram shows a simple VLAN implementation. For security reasons, it was decided that the network management, vehicle traffic monitoring and vehicle traffic control functions need to be segregated.



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VLAN enabled switch #1 is located in the Network Operations Center. It is configured to support the management, traffic monitoring and traffic control VLANs on the first three Ethernet ports respectively. A fourth port, located in the bottom row of Ethernet ports, is configured as the trunk port. Workstations connected to the first Ethernet port will only see network management data, workstations connected to the second Ethernet port will only see traffic monitoring data, and workstations connected to the third Ethernet port will only see traffic control data. The bottom Ethernet port is configured as a trunk port, and carries data from all VLANs.

VLAN enabled switch #2 is located in a traffic control cabinet. The first Ethernet port is configured as a trunking port, and carries data from all VLANs. The bottom Ethernet ports are configured to allow traffic monitoring data to the cameras, and traffic control data to the traffic controller.

The colored lines show the traffic that is present on the various network connections. In this example, data associated with the cameras (control commands to the cameras and video streams from the cameras) will be present in the green and black links. The camera data will not be present in the blue and orange links.

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ENCOM Radio VLAN Support

By default, VLAN tagged data will flow through ENCOM radios. If you plan to use the ENCOM radios solely as a carrier (i.e. a wire) between two VLAN enabled switches or routers, you do not have to make any configuration changes.

If you need the radios to perform specific VLAN related operations, you will need to set the appropriate configuration options in the VLAN sub-tab of the radio configuration form's Network tab.

The following VLAN operations are supported by the ENCOM radios:

- Specifying a Management VLAN
- Client tagging
- Client Tagging with a Management VLAN
- Pruning VLANs

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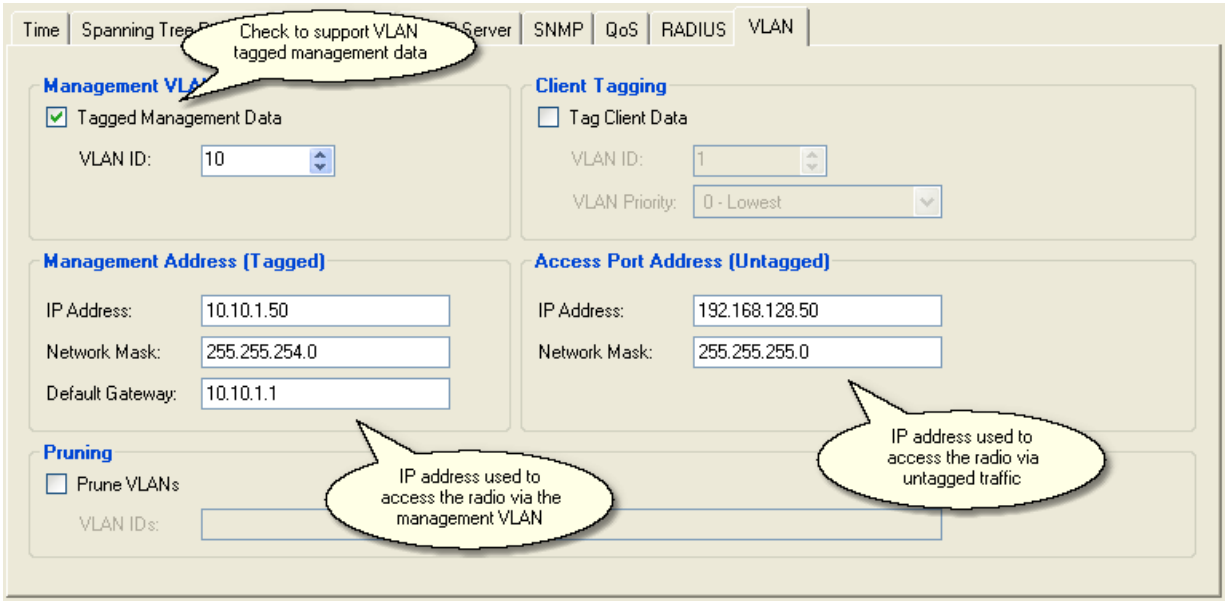
Specifying a Management VLAN

By default, ENCOM radios are assigned a single IP address. This IP address is used to manage and configure the radio using the native (untagged) VLAN.

If you want to use a specific management VLAN to access the radios, you will need to configure the *Management VLAN*, *Management Address* and *Access Port Address* sections of the radio configuration form's VLAN sub-tab:



When **Management VLAN** tagging is enabled, the radio is assigned two IP addresses: a management address will be used to access the radio using the management VLAN, and an access port address that will be used to access the radio using untagged traffic. You will be able to access the radio using either address from either the wireless or Ethernet interfaces. Because of this, you will need to prevent untagged data from being allowed onto the wireless part of the network if you want to restrict radio management activities to the management VLAN only.

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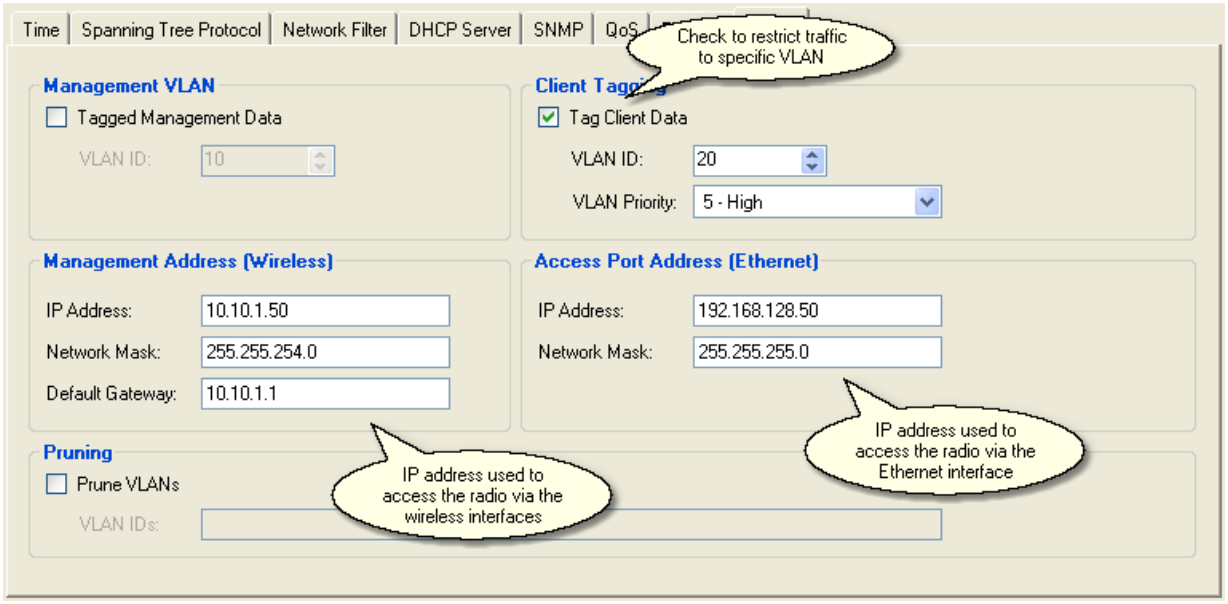
Client Tagging

By default, all of the ENCOM radio interfaces (wireless and Ethernet) operate as VLAN trunks. All tagged and untagged data will flow through the interfaces unhindered.

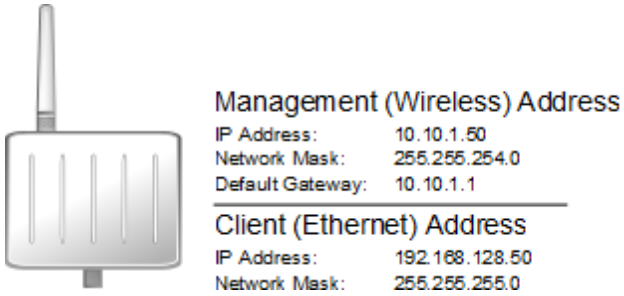
If you want to limit the network traffic on the radio's Ethernet port to a specific VLAN, you will need to configure the the *Client Tagging*, *Management Address* and *Access Port Address* sections of the radio configuration form's VLAN sub-tab:



When **Client Tagging** is enabled, the radio is assigned two IP addresses: one address will be used by the radio's wireless interfaces, and the other will be used for the radio's Ethernet port. Both IP addresses can be used to manage the radio.

Only tagged network data packets (using VLAN ID 20) are allowed on the Ethernet port. Incoming packets associated with VLAN ID 20 are automatically untagged and forwarded to the client devices. Outgoing packets sent by the client devices are automatically tagged with VLAN ID 20.

The management and client IP addresses are assigned to the radio as shown in the following diagram:



The management IP address, network mask and default gateway must be the compatible with the other radios in the wireless network.

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Any devices that are connected to the radio's Ethernet port must be assigned IP addresses and network masks that are compatible with the specified client VLAN.

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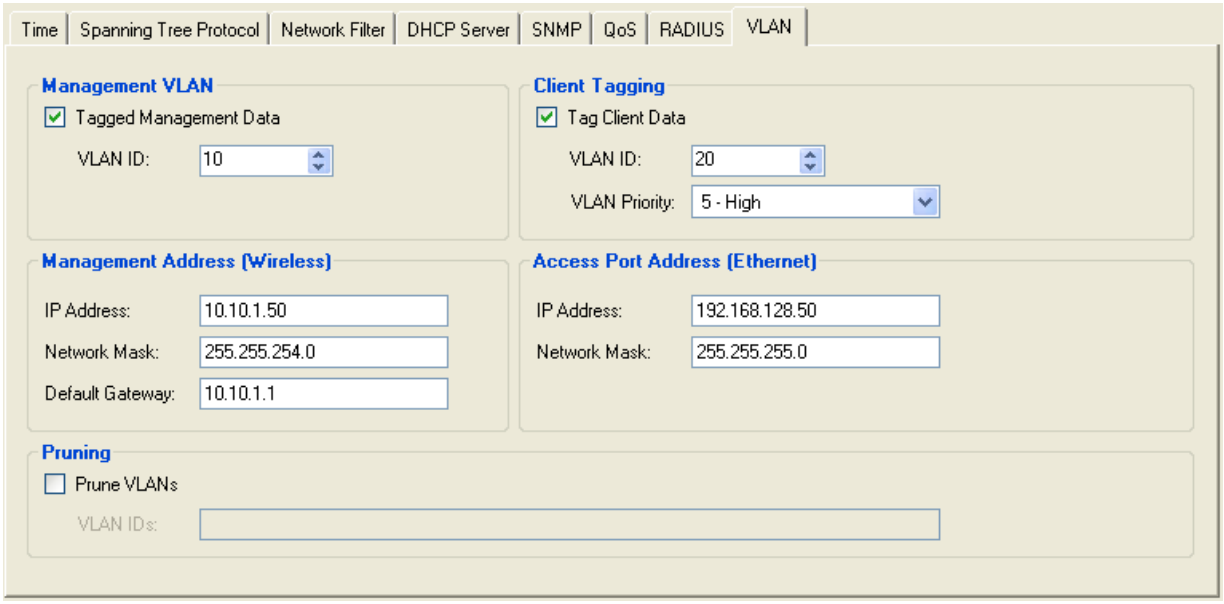
Client Tagging with a Management VLAN

In this scenario, a specific management VLAN is used to access the radios, and the network traffic on the radio's Ethernet port is limited to a specific VLAN.

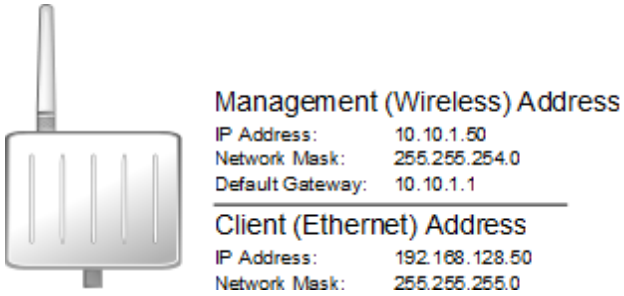
In this case, you will need to configure the *Management VLAN*, *Client Tagging*, *Management Address* and *Access Port Address* sections of the radio configuration form's VLAN sub-tab:



Like the case where only the **Client Tagging** option is enabled, the radio will be assigned two IP addresses: one address will be used by the radio's wireless interfaces, and the other will be used for the radio's Ethernet port. Both IP addresses can be used to manage the radio. The only difference is that the radio management traffic must use the specified management VLAN.

Only tagged network data packets (using VLAN ID 20) are allowed on the Ethernet port. Incoming packets associated with VLAN ID 20 are automatically untagged and forwarded to the client devices. Outgoing packets sent by the client devices are automatically tagged with VLAN ID 20.

The management and client IP addresses are assigned to the radio as shown in the following diagram:



The management IP address, network mask and default gateway must be the compatible with the other radios in the wireless network.

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Any devices that are connected to the radio's Ethernet port must be assigned IP addresses and network masks that are compatible with the specified client VLAN.

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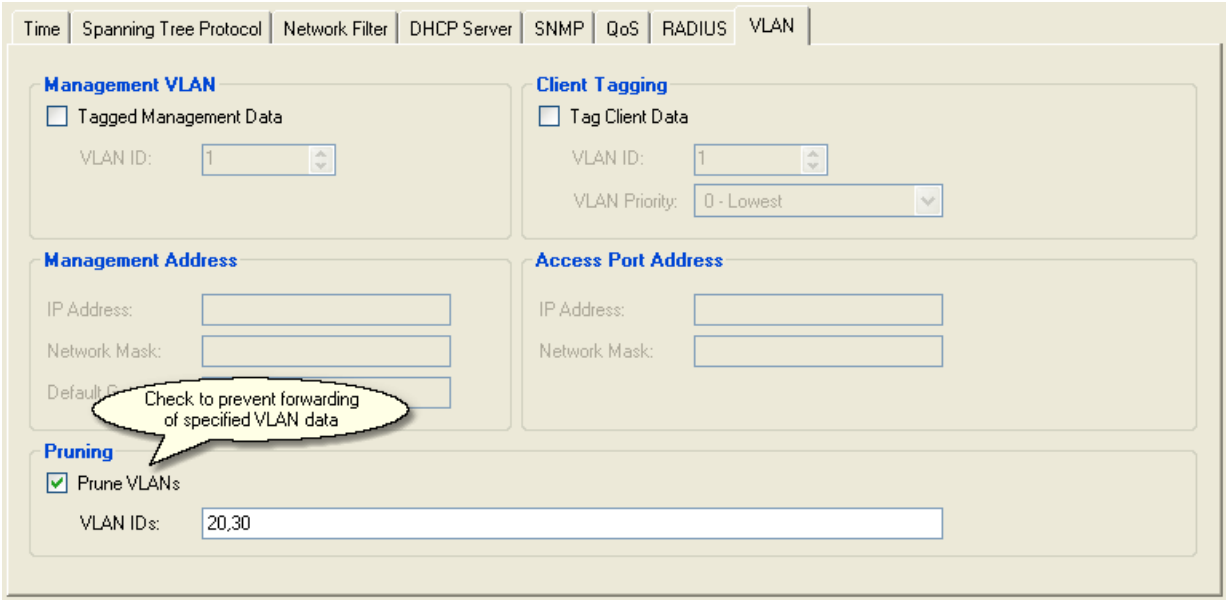
Pruning VLANs

By default, the ENCOM radios will forward all VLAN traffic to all of the radios to which it is connected. In certain situations (e.g. for performance or security reasons), you may want to prevent a radio from forwarding traffic from certain VLANs to other radios. In order to do this, you will need to configure the *VLAN Pruning* section of the radio configuration form's VLAN sub-tab:



When VLAN pruning is enabled, packets that are tagged with the VLAN IDs specified in the **VLAN IDs** field will not be forwarded to other radios.

Please refer to the following topics for more information on the two most common VLAN pruning scenarios:

- VLAN Pruning for Performance
- VLAN Pruning for Security

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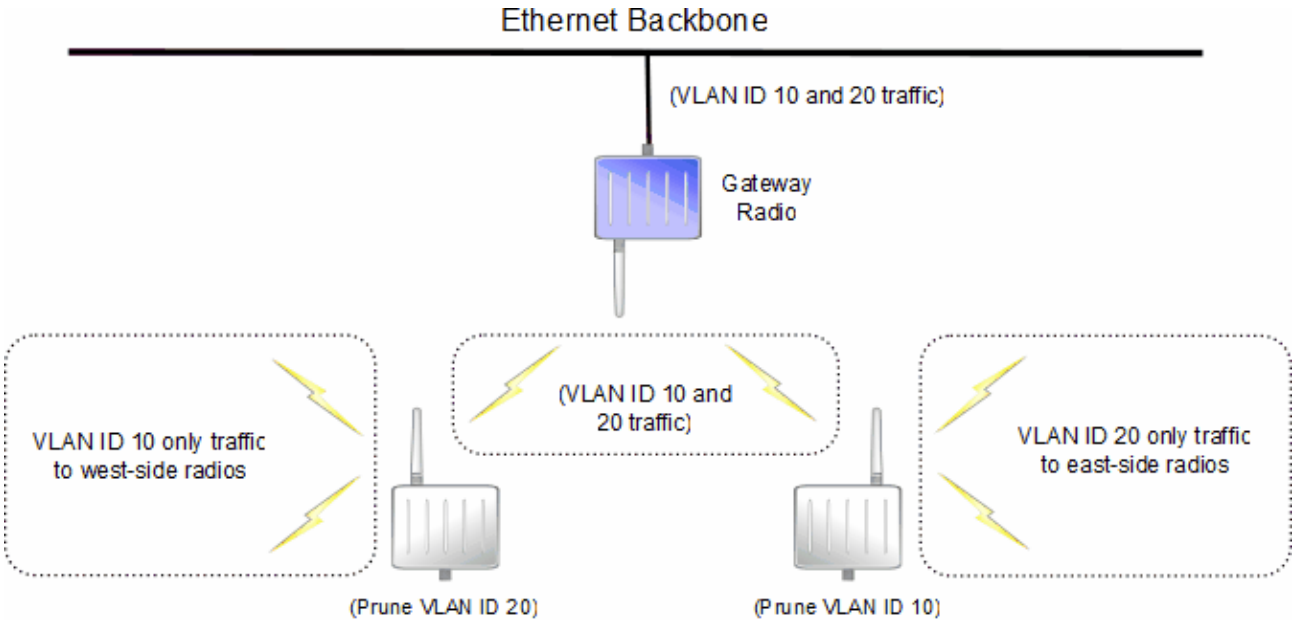
VLAN Pruning for Performance

VLAN pruning can be used to increase the performance of a network by preventing traffic from being forwarded to radios that do not need it. For example, in the diagram shown below, a radio network provides coverage for a large town.


Ethernet Backbone
(VLAN ID 10 and 20 traffic)
Gateway Radio
VLAN ID 10 only traffic to west-side radios
(VLAN ID 10 and 20 traffic)
VLAN ID 20 only traffic to east-side radios
(Prune VLAN ID 20)
(Prune VLAN ID 10)

To reduce the network traffic overhead, two VLANs were defined: VLAN ID 10, and VLAN ID 20. The VLANs are used to separate the network traffic associated with the radios in the west side of the town from the network traffic associated with the radios in the east side of the town.

The gateway radio, and the two downstream radios that are connected to the gateway radio, carry traffic for both VLANs. The left-hand downstream radio is configured to prune VLAN ID 20, and the right-hand downstream radio is configured to prune VLAN ID 10. Because of this, only the network packets associated with VLAN ID 10 are forwarded to the west-side radios, and only the network packets associated with VLAN ID 20 are forwarded to the west-side radios.

Note that the same effect could be obtained by using a dual radio for the gateway radio, and specifying a different SSID for each of the radio's wireless interface cards. The east-side radios would be configured with one of the SSIDs, and the west-side radios would be configured with the other SSID. Since radios can only communicate with other radios that use the same SSID, this would effectively isolate the east-side network traffic from the west-side network traffic.

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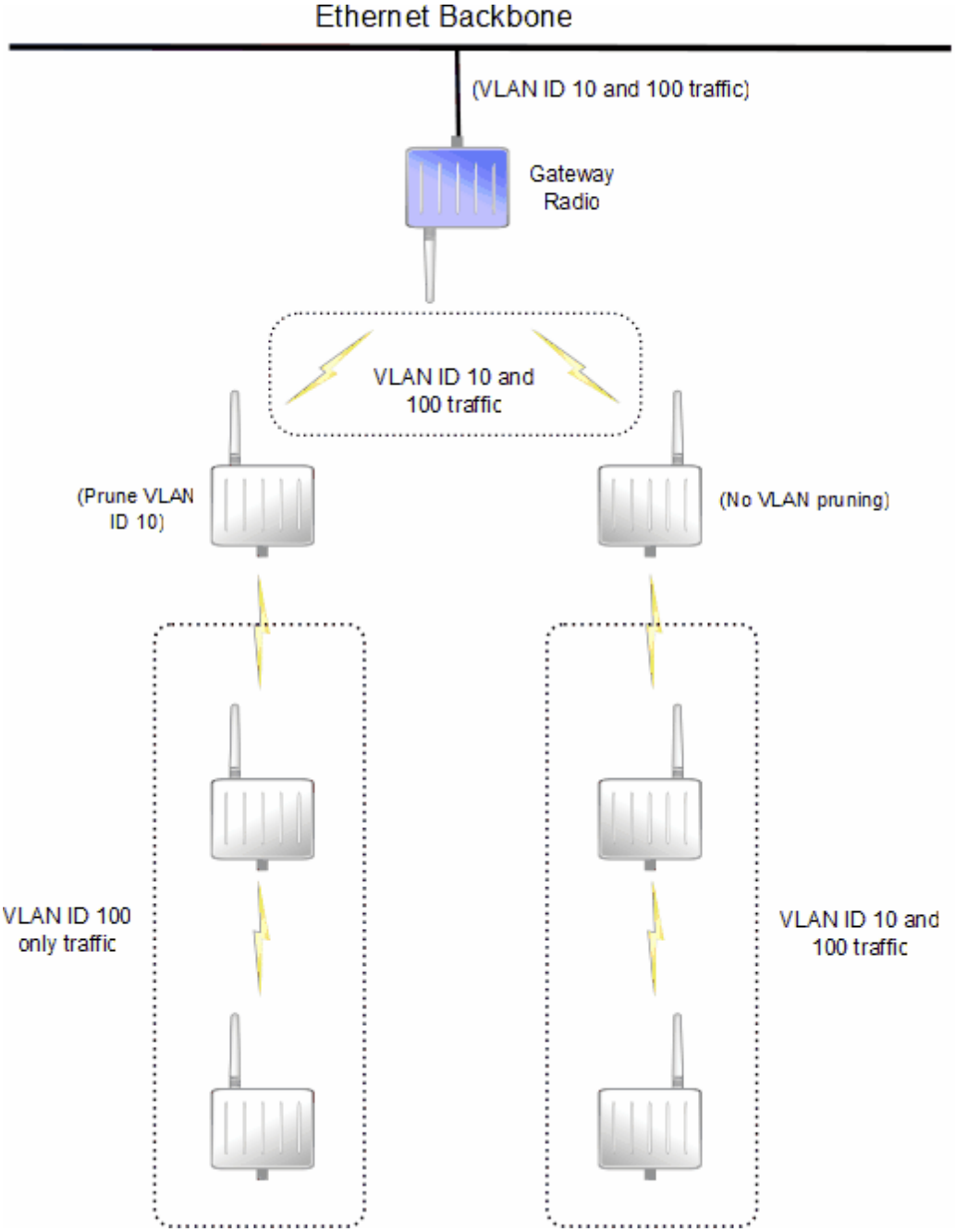
VLAN Pruning for Security

VLAN pruning can be used to increase security by preventing access to sensitive network resources. The following diagram shows a small network.


Ethernet Backbone
(VLAN ID 10 and 100 traffic)
Gateway Radio
VLAN ID 10 and 100 traffic
(Prune VLAN ID 10)
(No VLAN pruning)
VLAN ID 100 only traffic
VLAN ID 10 and 100 traffic

The radios on the right hand side of the diagram carry sensitive traffic that network administrator wants to limit access to. The sensitive traffic was assigned to VLAN ID 10, and the remaining traffic

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assigned to VLAN ID 100. The left-hand radio that is downstream from the gateway radio was configure to prune VLAN ID 10. This prevents any sensitive traffic from being routed to the remaining left-hand radios.

Note that the VLAN pruning is configured at each ENCOM radio. It is not compatible with the pruning functionality of the VLAN Trunking Protocol (VTP) implemented by Cisco switches.

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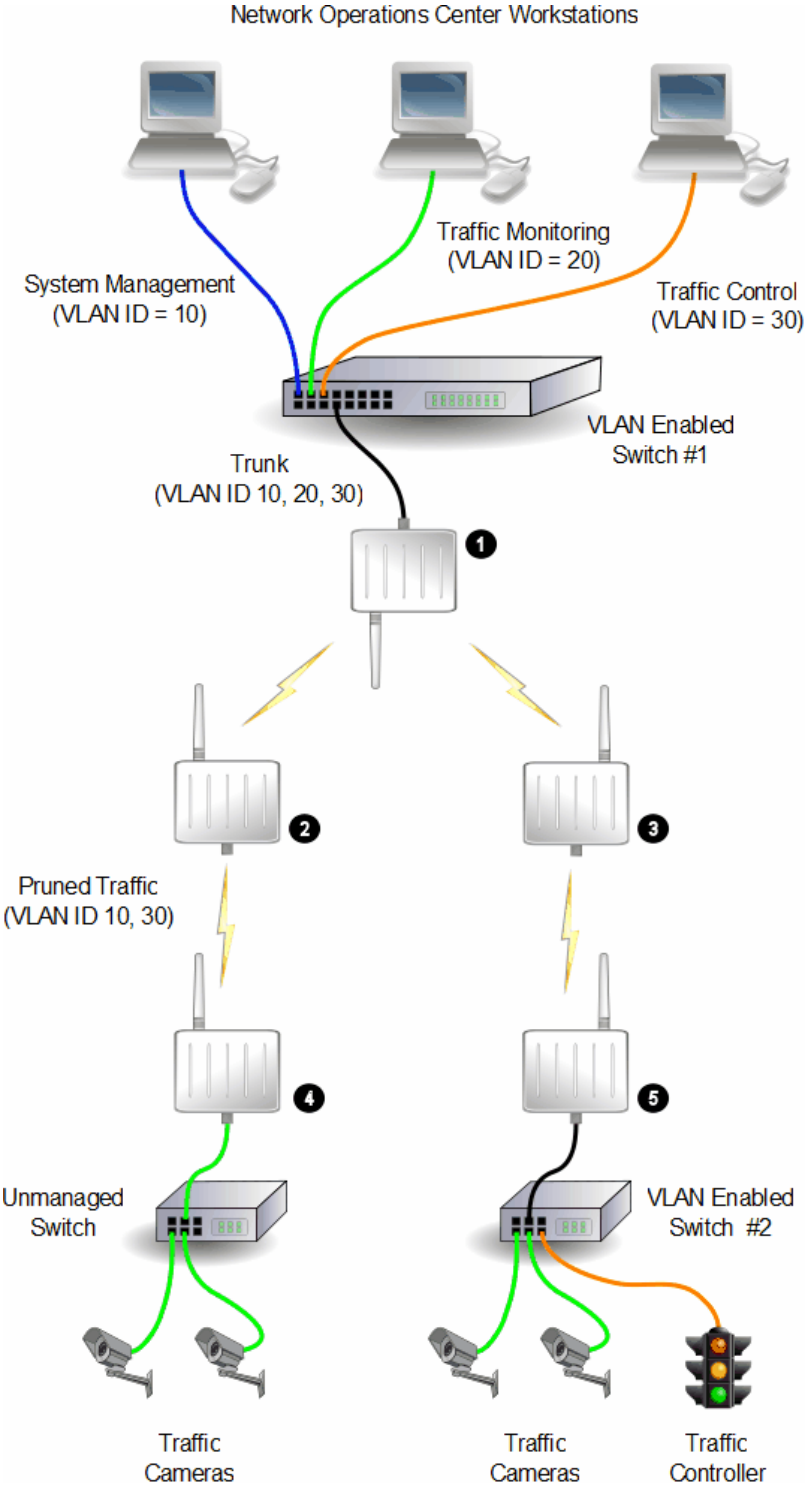
Detailed VLAN Configuration Example

The following diagram shows a small radio network that uses VLANs to isolate the network traffic between network management, vehicle traffic monitoring and vehicle traffic control roles.



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A management VLAN (ID = 10) is used to configure and monitor the radios, switches and routers in the network.

Low sensitivity vehicle traffic monitoring data (video feeds) is assigned to VLAN ID 20. More sensitive vehicle traffic control data is assigned to VLAN ID 30.

Traffic controller data is prevented from being routed to the left hand portion of the network by the appropriate VLAN pruning setting on radio 2.

The VLAN configuration settings for each of the 5 radios, and for each of the VLAN enabled switches, are described in the following topics:

- VLAN Enabled Switch #1 Configuration
- Radio 1 VLAN Configuration
- Radio 2 VLAN Configuration
- Radio 3 VLAN Configuration
- Radio 4 VLAN Configuration
- Radio 5 VLAN Configuration
- VLAN Enabled Switch #2 Configuration

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VLAN Enabled Switch #1 Configuration

VLAN enabled switch #1 would normally be located in the Network Operations Center.

The switch is configured to support the management, traffic monitoring and traffic control VLANs on the first three Ethernet ports respectively. Workstations connected to the first Ethernet port will only see network management data, workstations connected to the second Ethernet port will only see traffic monitoring data, and workstations connected to the third Ethernet port will only see traffic control data.

The bottom Ethernet port is configured as a trunking port, and carries data from all VLANs.

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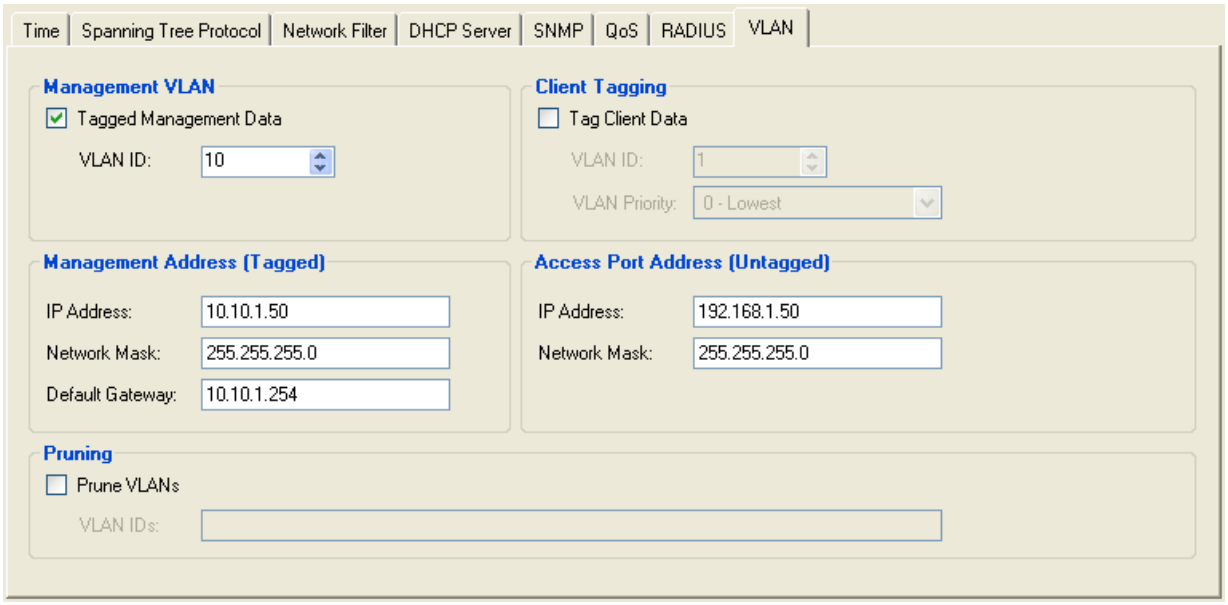
Radio 1 VLAN Configuration

The VLAN configuration for Radio 1 would be as follows:



The Management VLAN is enabled and set to VLAN ID 10. The IP address of the radio's wireless interface is set to a value that is compatible with the other radios in the network.

The radio's Ethernet port is connected to the trunk port on VLAN enabled switch #1. It is assigned an IP address that can be used for local (on-site) access.

As configured, the radio will carry network traffic from all VLANs.

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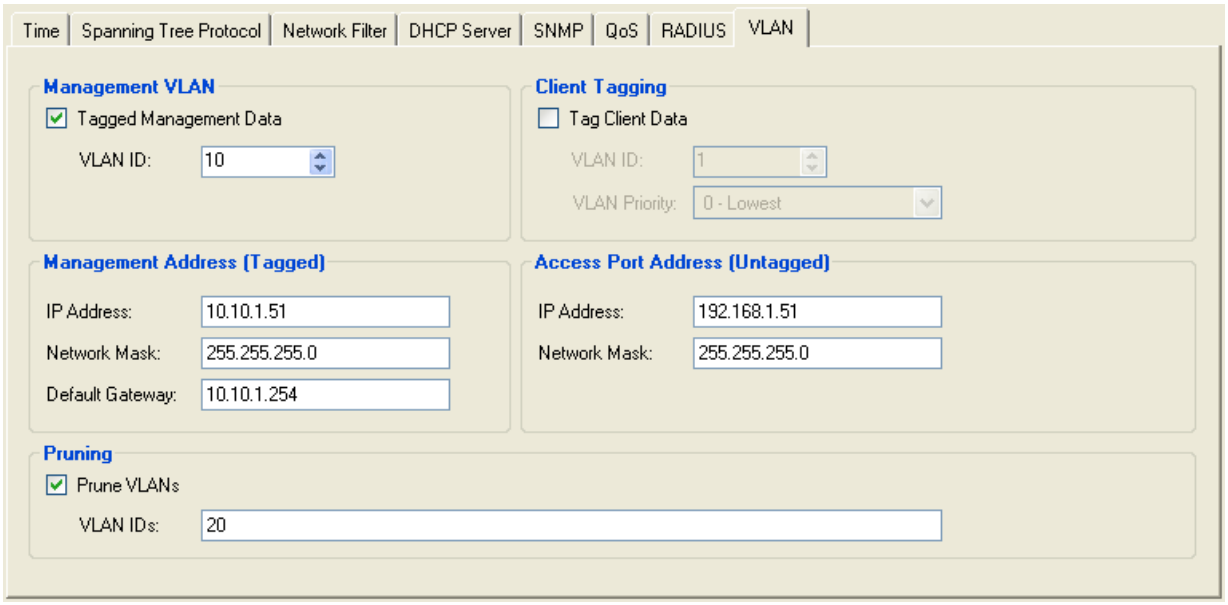
Radio 2 VLAN Configuration

The VLAN configuration for Radio 2 would be as follows:



The Management VLAN is enabled and set to VLAN ID 10. The IP address of the radio's wireless interface is set to a value that is compatible with the other radios in the network. Although the radio's Ethernet interface is not used, it is still assigned an IP address that can be used for local (on-site) access.

To prevent traffic controller data from being routed to the left-hand radios, VLAN ID 20 is pruned by the radio. Only network traffic from VLAN ID 10 and 30 will be allowed on the left-hand radios.

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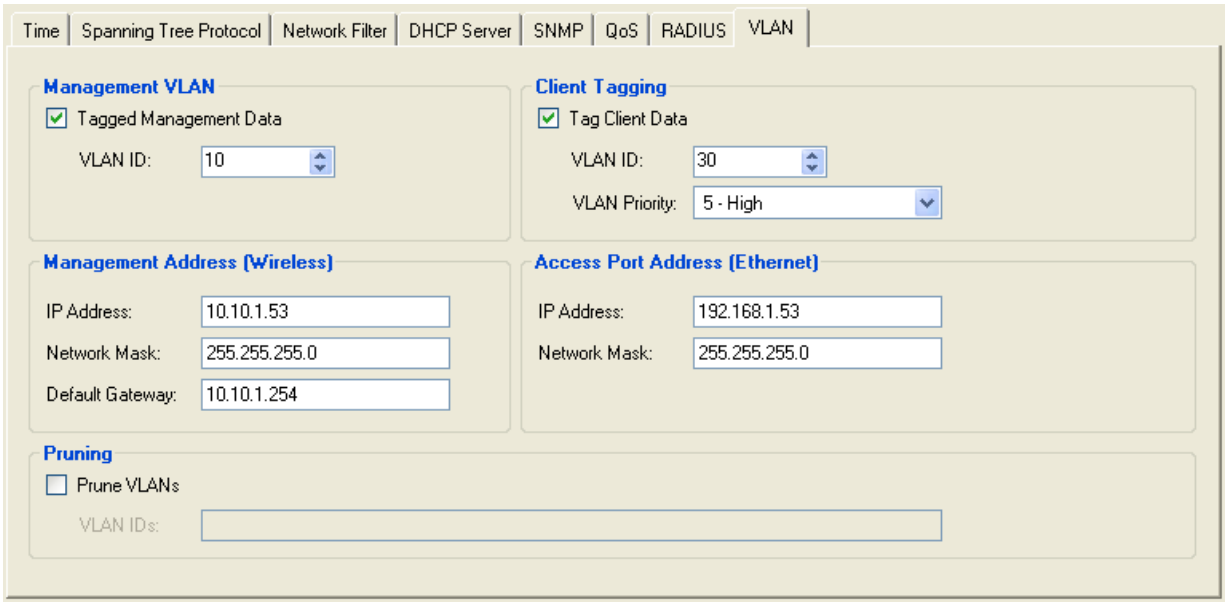
Radio 3 VLAN Configuration

The VLAN configuration for Radio 3 would be as follows:



The Management VLAN is enabled and set to VLAN ID 10. The IP address of the radio's wireless interface is set to a value that is compatible with the other radios in the network. Although the radio's Ethernet interface is not used, it is still assigned an IP address that can be used for local (on-site) access.

As configured, the radio will carry network traffic from all VLANs.

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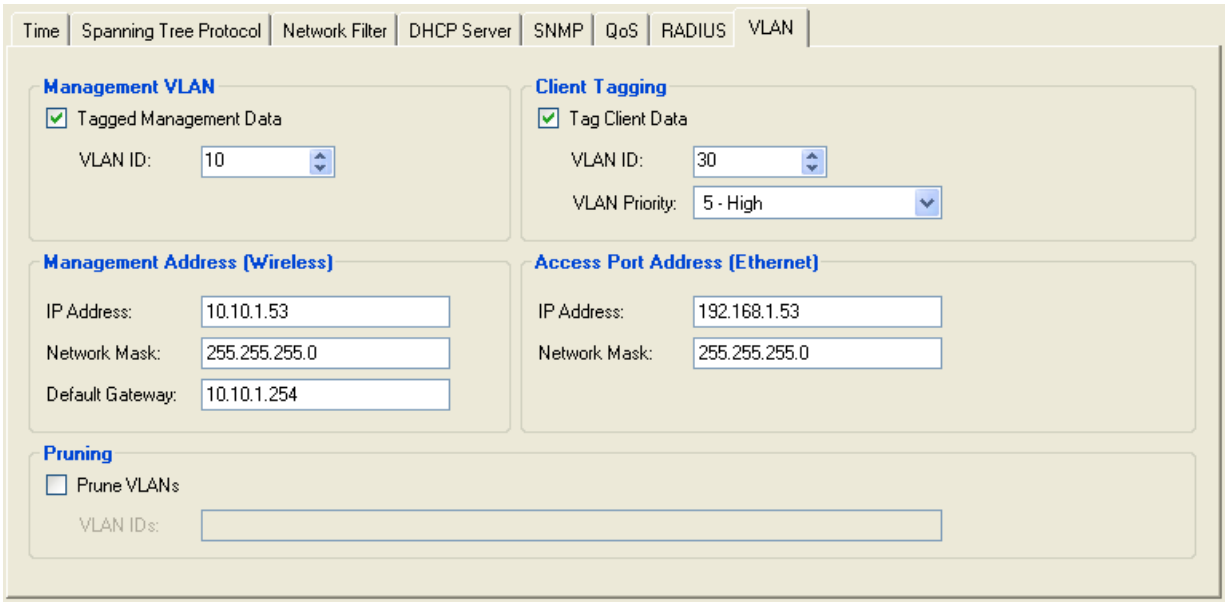
Radio 4 VLAN Configuration

The VLAN configuration for Radio 4 would be as follows:



The Management VLAN is enabled and set to VLAN ID 10. The IP address of the radio's wireless interface is set to a value that is compatible with the other radios in the network.

According to the network diagram, only traffic cameras are connected to this radio. Because of this, it is possible to perform VLAN tagging within the radio. The radio is therefore configured to tag the Ethernet traffic with VLAN ID 30. This will present the network traffic from VLAN ID 30 as untagged data on the radio's Ethernet port. Data sent from the cameras will automatically be tagged with VLAN ID 30 by the radio. Network traffic from the other VLANs will not be present on the Ethernet port.

Since the radio's Ethernet interface is directly connected to the cameras, it (and the cameras) must be assigned an IP address that is compatible with the network address range assigned to VLAN ID 30.

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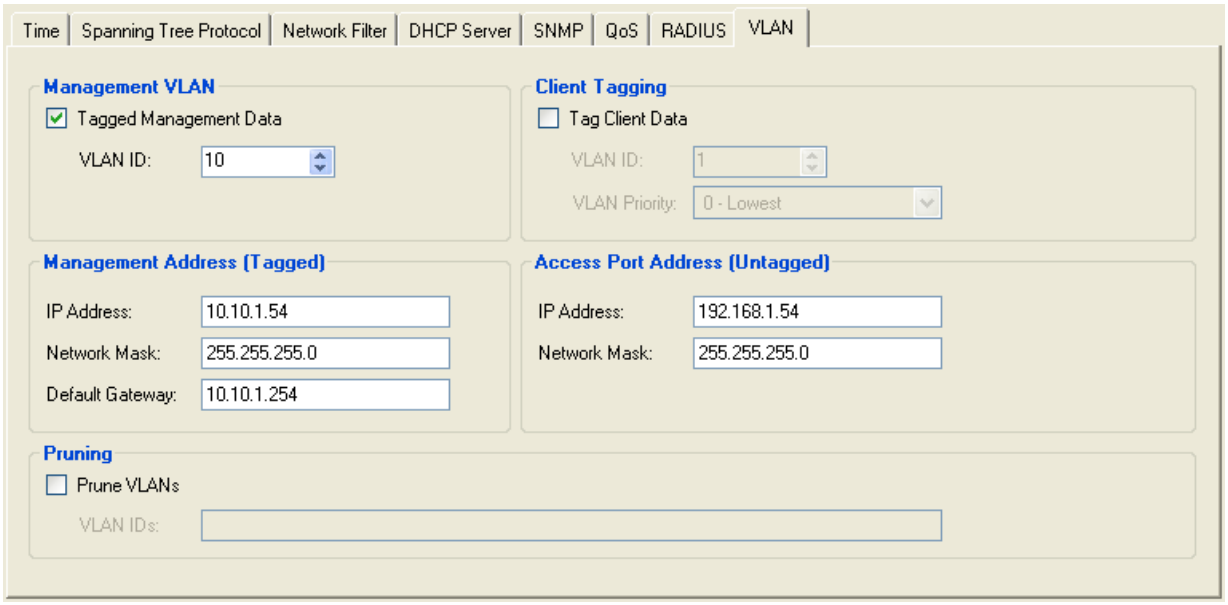
Radio 5 VLAN Configuration

The VLAN configuration for Radio 5 would be as follows:



The Management VLAN is enabled and set to VLAN ID 10. The IP address of the radio's wireless interface is set to a value that is compatible with the other radios in the network.

According to the network diagram, both traffic cameras and controllers are connected to this radio. Each type of device is assigned to a different VLAN. Since ENCOM radios only support a single Ethernet port, they are not able to tag traffic for both VLANs. Because of this, a small managed switch (VLAN enabled switch #2) is used to tag the traffic associated with the devices. The radio's Ethernet port is connected to the trunk port on the switch. It is assigned an IP address that can be used for local (on-site) access.

As configured, the radio will carry network traffic from all VLANs.

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VLAN Enabled Switch #2 Configuration

VLAN enabled switch #2 would normally be located in a cabinet located close to a road or intersection.

The center port located in the top row of Ethernet ports is configured as a trunk port, and carries data from all VLANs.

The first and second ports in the bottom row of Ethernet ports is configured to support the traffic monitoring VLAN (ID = 20). The third port is configured to support the traffic controller VLAN (ID = 30).

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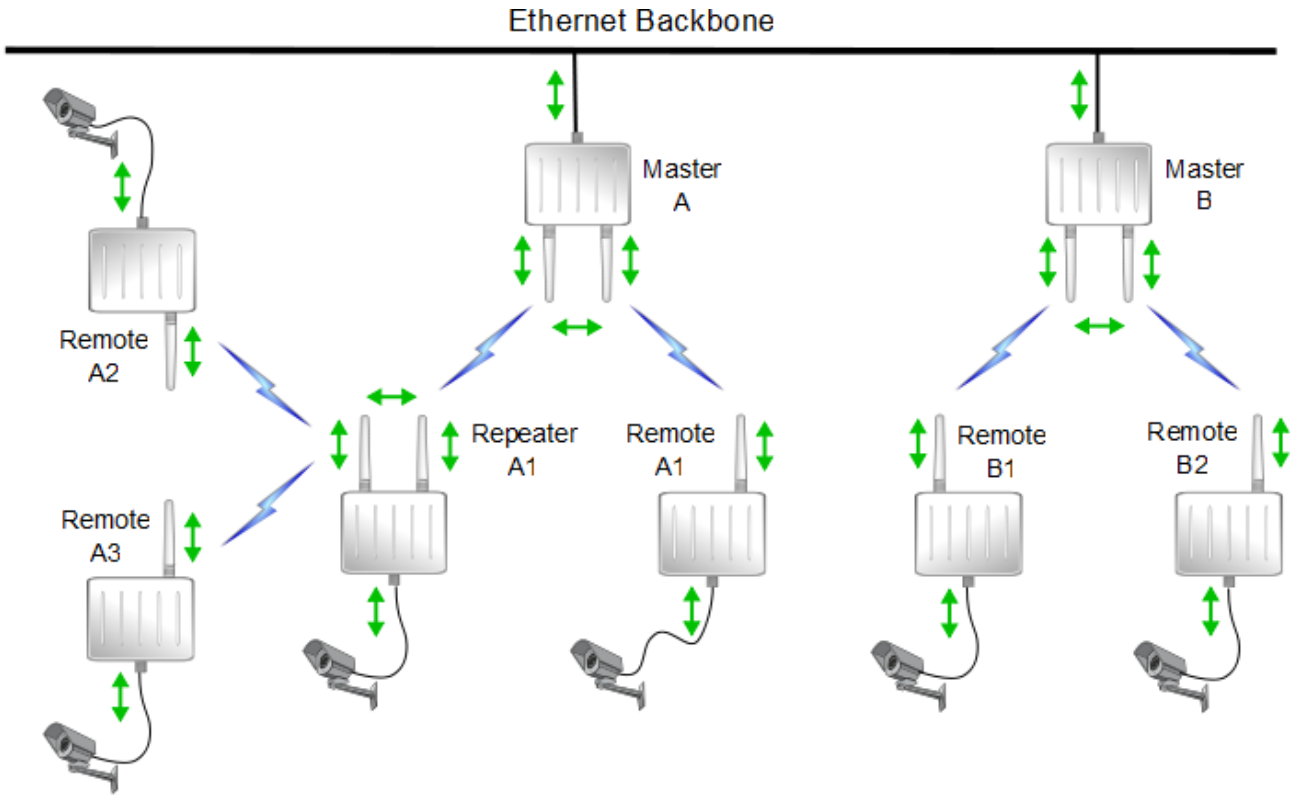
Appendix F: Network Filters

The following example shows a small network used to carry video from traffic cameras to the network operations center. The traffic cameras have been configured to multicast the video data so that any workstation connected to the network operation center's Ethernet backbone can view the traffic video streams. The two master radios are also connected directly to the Ethernet backbone without any intervening switches or routers.



The green arrows highlight the directions in which the video traffic can flow. By default, the video traffic will flow unimpeded from any radio to any radio.

Due to the bridging architecture used by the Encom radio network, the video traffic generated by each camera is automatically forwarded to all of the radios in the network. This can lead to significant network congestion if a large number of cameras are present in the network.

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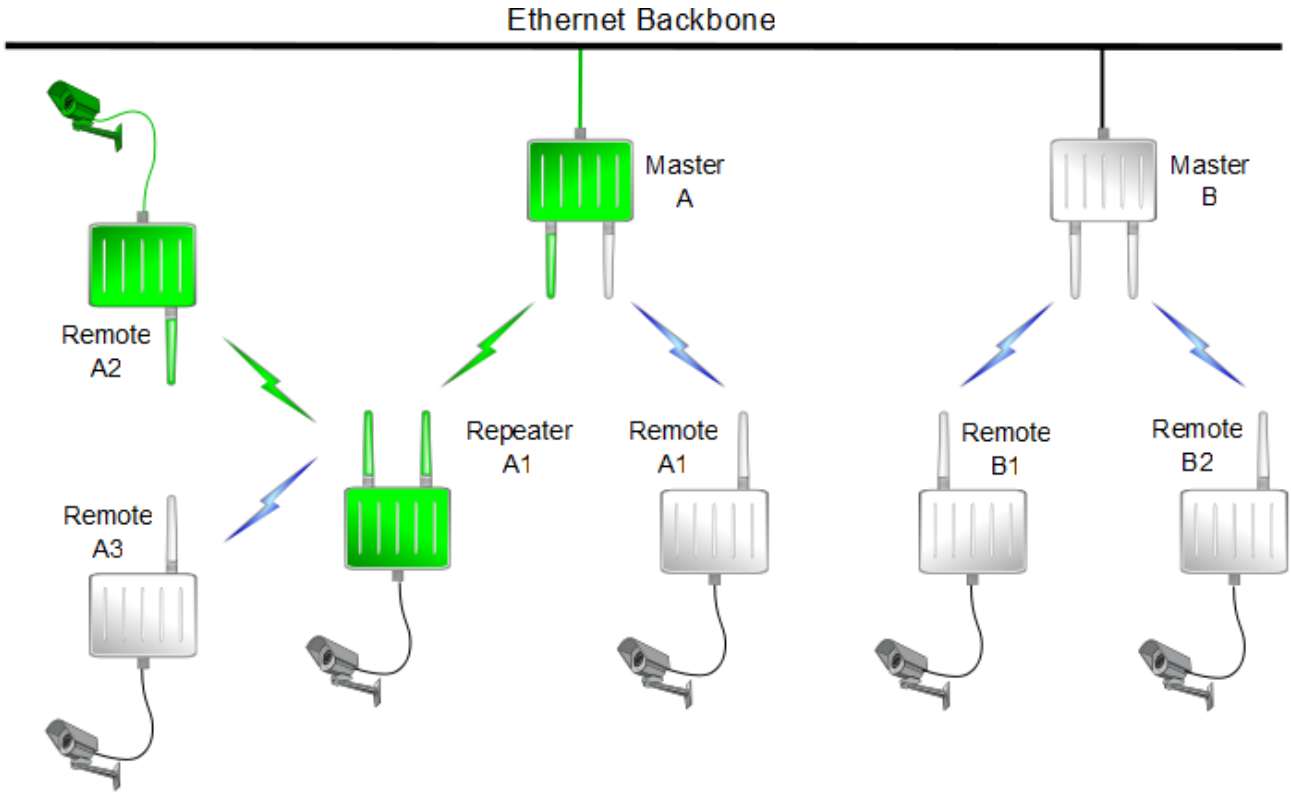
For example, consider the video collected by the camera attached to the 'Remote A2' radio. To reach the network operation center workstations, the video traffic needs to pass through the 'Repeater A1' and 'Master A' radios. There is no need for the video to be forwarded to any other radio in the network. The path required by the video is highlighted in green in the following diagram:



By applying the appropriate multicast network filters, you can prevent the video from being forwarded to radios that do not require it. The following topics describe how to configure the radios to prevent unnecessary video traffic in the network:

- Master Radio Configuration
- Repeater Radio Configuration
- Remote Radio Configuration

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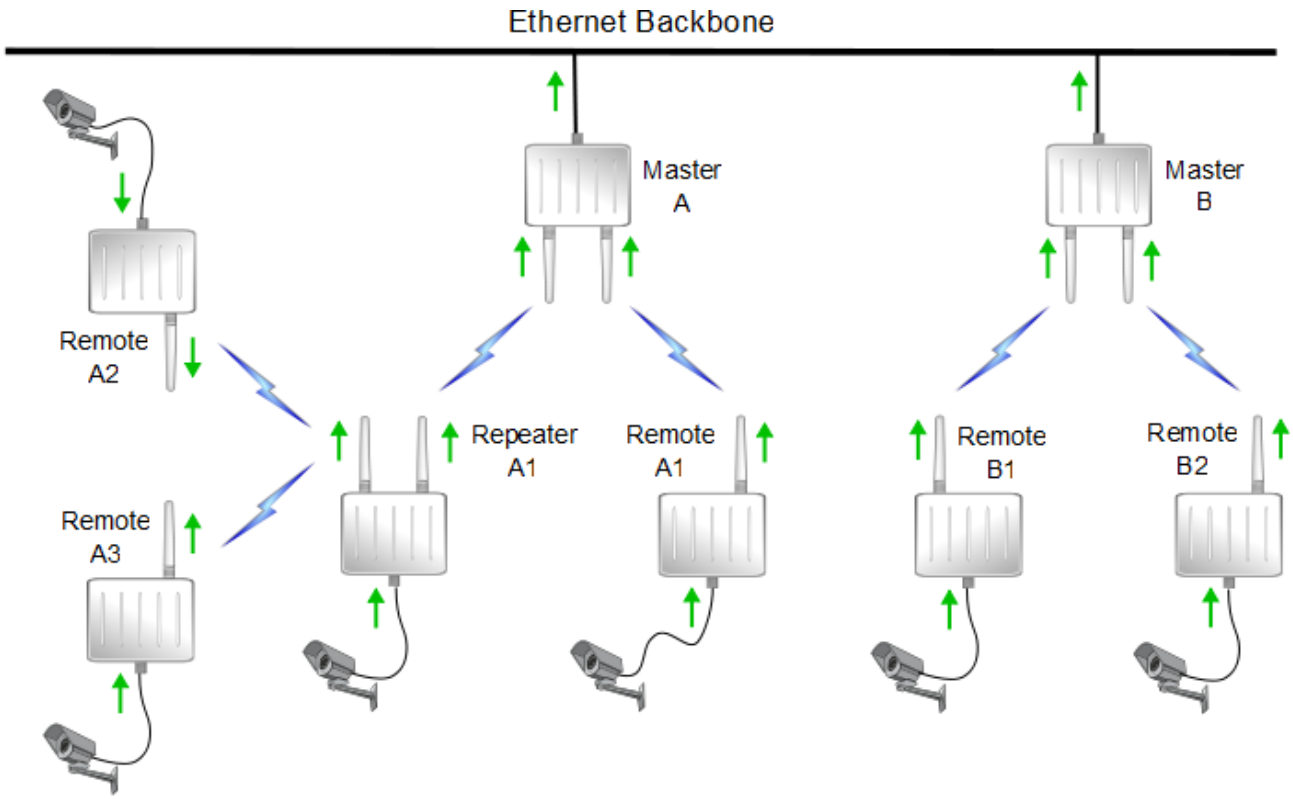
When the network filters have been properly configured, the multicast traffic will only be forwarded to the required upstream radios, as shown in the following diagram:



The green arrows show the direction in which the video traffic can flow. Note that the traffic flows cleanly between the radios that collect the video and the workstations connected to the network operation center backbone. Because the unnecessary network traffic has been eliminated, the network will be able to support more cameras than a network where the multicast traffic is not filtered.

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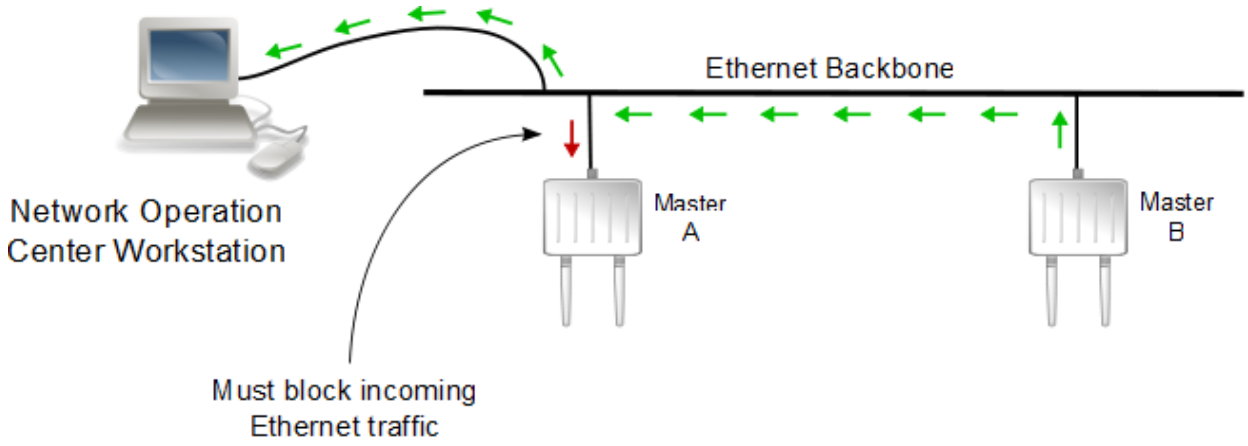
Master Radio Configuration

The master radios collect the video data from their downstream radios (repeaters and remotes) and forward it to the network operation center workstations via the Ethernet backbone.

In order to prevent unnecessary video traffic from being forwarded to other radios, it is necessary to filter out the following traffic:

- Multicast traffic entering the master radio's Ethernet port must be blocked. Otherwise, video traffic forwarded by the other master radio would in turn be forwarded to the master radio's downstream radios. In the example, we do not want the video traffic from 'Master B' radio being forwarded to the 'Master A' radio and its downstream radios:



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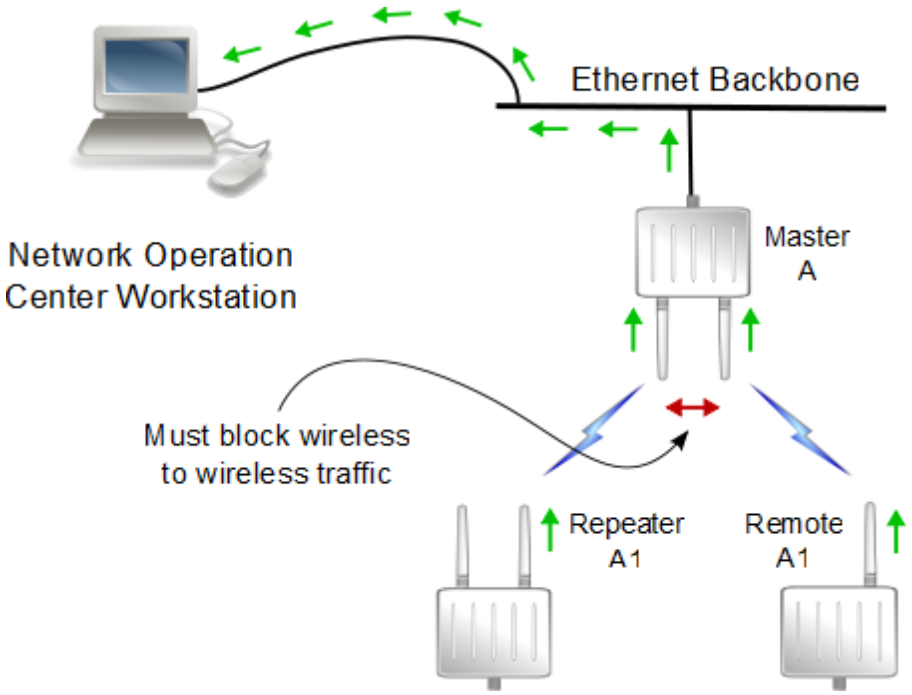
- Multicast traffic entering one of the master radio's wireless interfaces must not be forwarded to the radio's other wireless interfaces. This prevents the traffic from one downstream radio from being forwarded to another downstream radio.



NOTE

Blocking the wireless to wireless traffic will block multicast traffic between physical radio cards, the WDS links that form between the master radio and its downstream radios, and the wireless connections that form between wireless client devices (such as laptops or wireless cameras) and the radios.

In the case where the master radio contains a single radio card, but has wireless connections to two remote radios, blocking wireless to wireless traffic will prevent multicast traffic from being forwarded from one remote radio to another.

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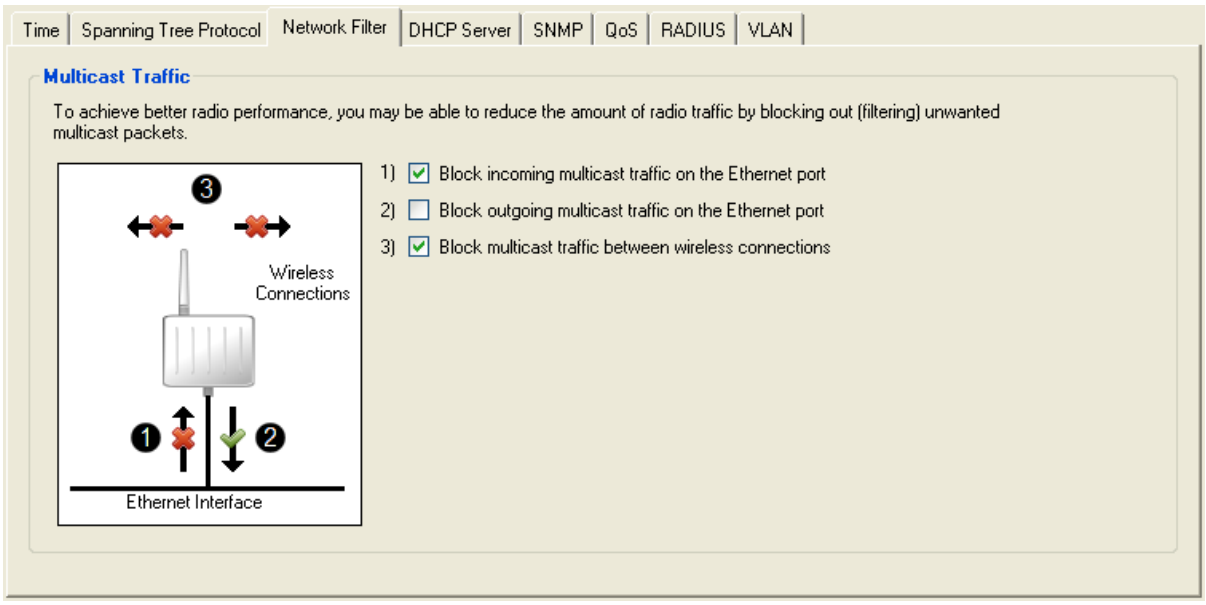
The following screen shot shows the the network filter configuration to use for the master radios:


Time
Spanning Tree Protocol
Network Filter
DHCP Server
SNMP
QoS
RADIUS
VLAN
Multicast Traffic
To achieve better radio performance, you may be able to reduce the amount of radio traffic by blocking out (filtering) unwanted multicast packets.
Wireless Connections
Ethernet Interface
1) Block incoming multicast traffic on the Ethernet port
2) Block outgoing multicast traffic on the Ethernet port
3) Block multicast traffic between wireless connections

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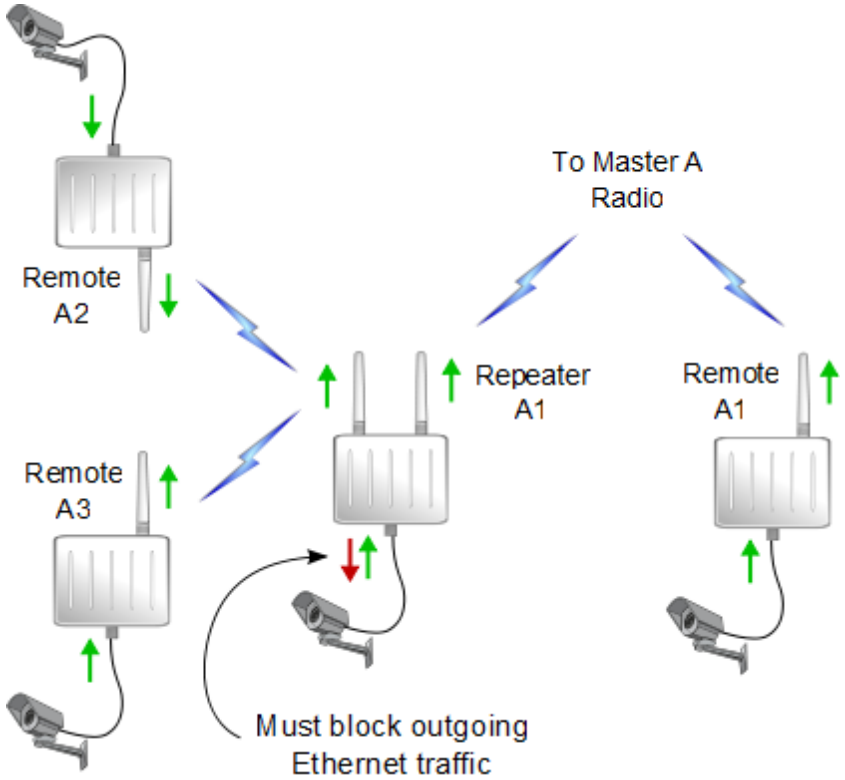
Repeater Radio Configuration

The repeater radios collect the video data from their downstream radios (remotes) and forward it to the network operation center workstations via the master radios. They may also collect video data from one or more cameras directly connected to their Ethernet ports.

In order to prevent unnecessary video traffic from being forwarded to other radios, it is necessary to filter out the following traffic:

- Multicast traffic exiting the master radio's Ethernet port must be blocked. Otherwise, video traffic received by the repeater would be forwarded to the devices connected to the repeater's Ethernet port. In the example, we do not want the video traffic from the 'Remote A2' and 'Remote A3' radios from being forwarded to camera connected to the repeater:



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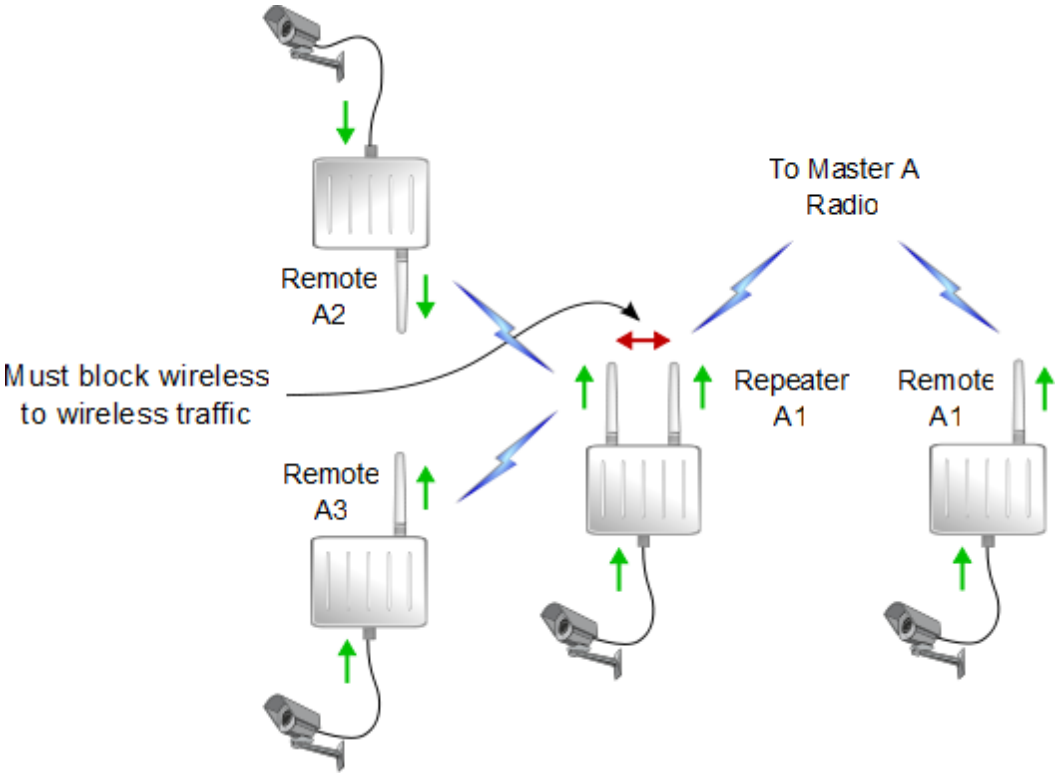
- Multicast traffic entering one of the repeater radio's wireless interfaces must not be forwarded to the radio's other wireless interfaces. This prevents the traffic from one downstream radio from being forwarded to another downstream radio.



NOTE

Blocking the wireless to wireless traffic will block multicast traffic between physical radio cards, the WDS links that form between the master radio and its downstream radios, and the wireless connections that form between wireless client devices (such as laptops or wireless cameras) and the radios.

In the case where the master radio contains a single radio card, but has wireless connections to two remote radios, blocking wireless to wireless traffic will prevent multicast traffic from being forwarded from one remote radio to another.

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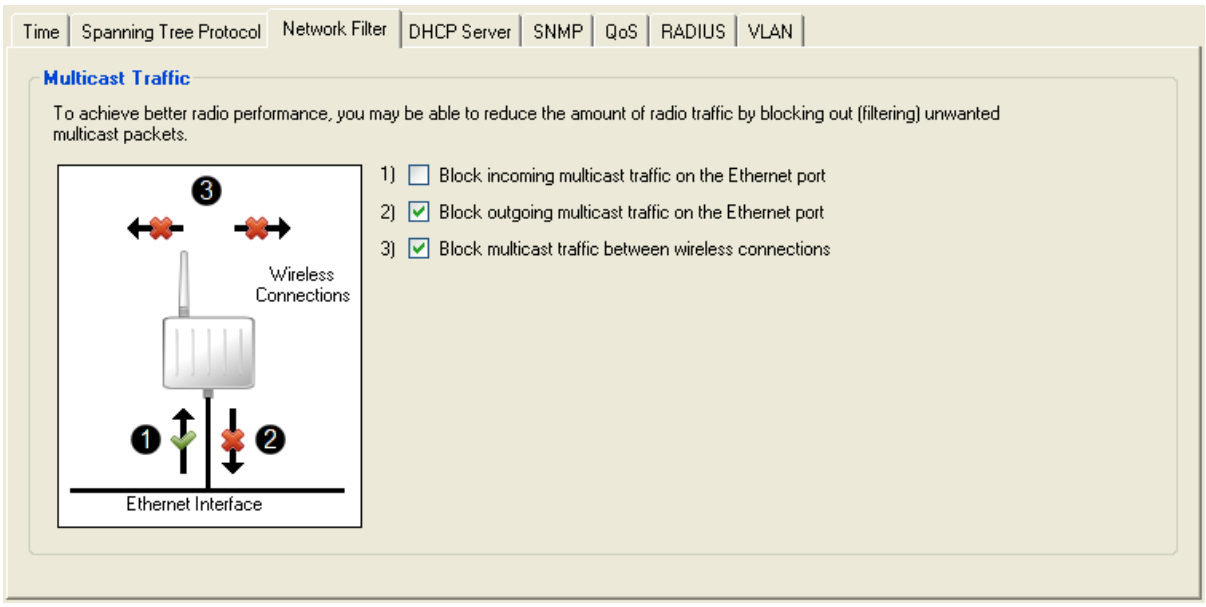
The following screen shot shows the the network filter configuration to use for the repeater radio:



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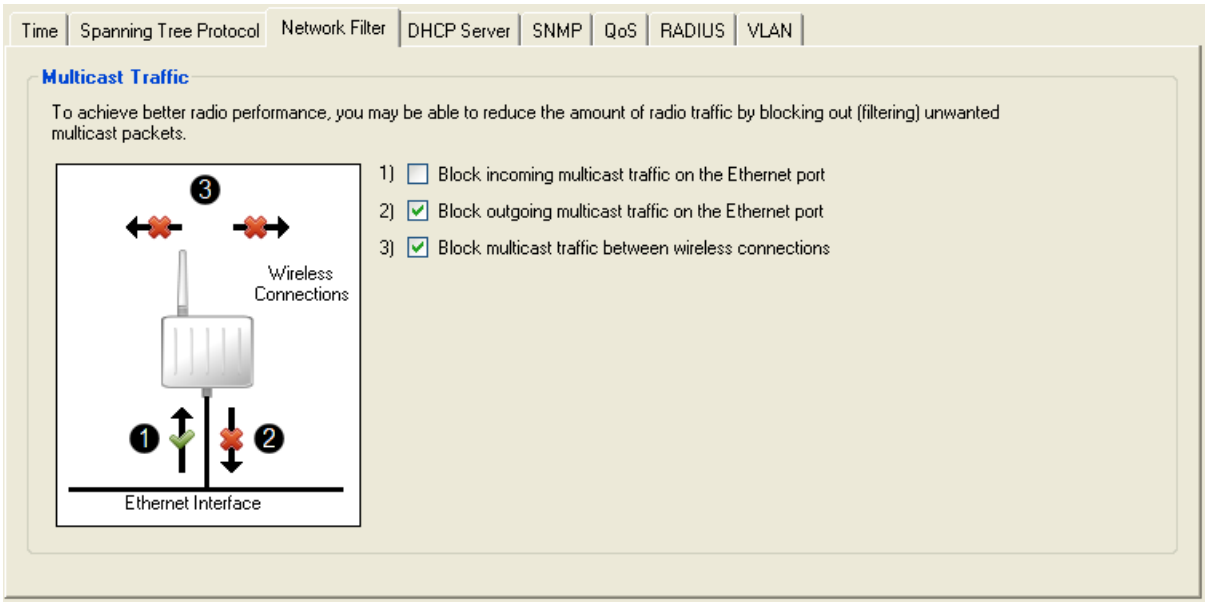
Remote Radio Configuration

The remote radios collect video data from one or more cameras directly connected to their Ethernet ports, and forward it to the network operation center workstations via the upstream (repeater or master) radios.

Since a remote radio will normally maintain a single wireless link to the upstream radio, there is usually no reason to block wireless to wireless traffic.

If you have wireless client devices (such as laptops or wireless cameras) connected to the remote radio, you may want to block the wireless to wireless traffic so that multicast traffic generated by one of the devices is not forwarded to the other devices. In addition, you may want to block outgoing Ethernet traffic so that the the multicast traffic generated by the wireless devices is not forwarded to the cameras connected to the Ethernet port.

The following screen shot shows the the network filter configuration to use for the remote radios (this is only required if you want to manage the multicast traffic generated by the locally attached devices):



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Appendix G: Securing Your Wireless Network

General Security Considerations

ENCOM radios provide a vital link between your network operations center and field devices (such as traffic controllers, traffic cameras, school zone beacons, etc.). To prevent unauthorized agents from gaining access to, and interfering with, your infrastructure, you need to configure the radios with the appropriate security settings. This appendix describes the configuration settings that affect the security of ENCOM radios, and recommendations that will maximize the security of your network.

In order to protect the entire system, the other devices that make up the network (computers, routers, switches, traffic controllers, traffic cameras, etc.) also need to be secured. Due to the great variety of these devices, it is not possible to address them in this document. Please refer to the documentation that was provided with these devices for more information.

Specific details and recommendations can be found in the following topics:

- Set the Administrative Password
- Secure Radio Configuration Settings
  - Broadband and Point-to-Multipoint radios
    - Radio Settings (N Cards)
    - Radio Settings (A and B/G Cards)
    - WDS Settings
    - Wireless Security Settings (N Cards)
    - Wireless Security Settings (A and B/G Cards)
  - Mesh radios
    - Radio Settings (Mesh Radios)
    - MAC Access Settings
    - Wireless Security Settings

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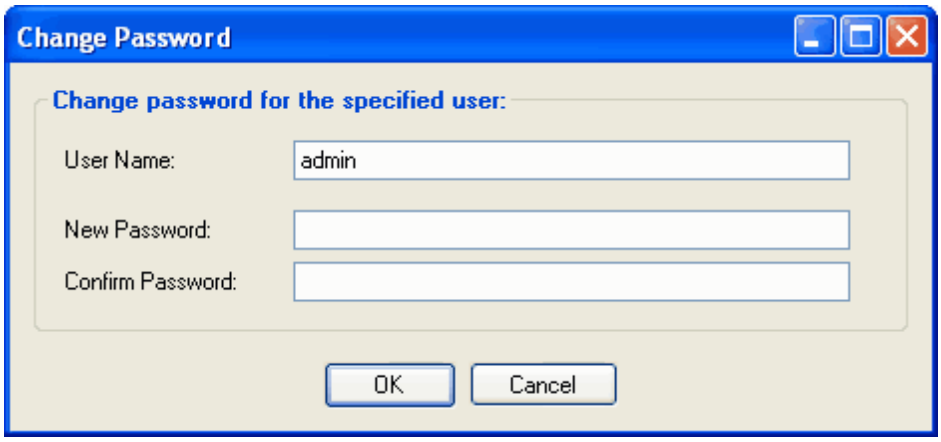
Set the Administrative Password

By default, the administrative password of an ENCOM radio is blank.You should assign a strong password to the radio before adding it to your network.

To secure access to the radio:

1. Run ENCOM STRATOS to access your network.
2. Select the radio you want to secure.
3. Select **Radio -> Change Password** from the main menu. The *Change Password* form is displayed:



4. Enter a strong password in the **New Password** field. The password should be at least 8 characters long, and contain a random combination of upper and lowercase letters, numbers and punctuation characters (except for the $, “ and ? characters).
5. Enter the same password in the **Confirm Password** field.
6. Press the **OK** button to save the new password to the radio.

NOTE

To more easily manage your network, you should use the same administrative password for all of your radios.

When you log into STRATOS, it uses the password you enter to log into the radios in your network. If a radio has been configured with a different password, a icon is displayed next to the radio in the radio list. STRATOS will not be able to access the radio until you explicitly log into it. To do this, click the left mouse button on the radio, and enter the appropriate credentials when prompted to.

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Secure Radio Configuration Settings

Broadband and Point-to-Multipoint radios

Radio Settings (N Cards)

This topic describes the radio settings used to secure Broadband and Point-to-Multipoint radios using Wireless-N radio cards.

To configure Broadband and Point-to-Multipoint radios with secure settings:

1. Run ENCOM STRATOS to access your network.
2. Select the radio you want to secure.
3. Select **Radio -> Configure** from the main menu. (Alternatively, just double-click the radio.)
4. Select the **Radio 1** tab, and the **Radio Settings** sub-tab.
5. Update the settings using the following guidelines:

Setting	Guideline
Network Type	If you don't need to support wireless client devices (e.g. laptops, smart-phones, wireless cameras), set this option to **N-Only** or **A-Only**. This prevents client devices from being able to connect to the radio, making your network harder to compromise.
Network SSID	Use an innocuous word or phrase, or a random combination of letters, numbers and punctuation (except for the $, \ and " characters). This prevents someone that discovers the network from easily determining the type of radios in the network, who the network belongs to, or what the network is being used for.
Hide SSID	Check this option to prevent the network SSID from being broadcast. This will prevent unauthorized client devices from detecting your network, and will prevent casual discovery of your network. If client devices are allowed to connect to the network, they will have to be manually configured with the SSID.
Channel Mode	Most wireless-N client devices can only detect networks that are using 20 MHz or 40 MHz channel modes.

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	If you do not need to support client devices, and your network does not need to handle a high amount of network traffic, you can set the channel mode to 5 MHz or 10 MHz. This will prevent casual discovery of your network.
Channel	If using a 5.8 GHz radio, and you do not need to support client devices, set the channel to a frequency that is not supported by client devices. This will prevent unauthorized devices from being able to detect your network. The following is a list of the 5.8 GHz band frequencies that are normally supported by client devices in North America: • 5180 MHz • 5200 MHz • 5220 MHz • 5240 MHz • 5745 MHz • 5765 MHz • 5785 MHz • 5805 MHz • 5825 MHz If using a 2.4 GHz radio, all of the available frequencies are supported by client devices. If using a 4.9 GHz radio, none of the available frequencies are supported by regular client devices (specialized 4.9 GHz client devices do exist).
Enable eMax Protocol	eMax is a proprietary protocol that increases the bandwidth of the wireless links. Since the protocol is not compatible with standard client devices, these devices will not be able to connect to a network that is using the eMax protocol.
Enable Roaming	If the radio is configured as a remote, it will by default connect to any compatible master radio it detects. To force the remote radio to connect to a specific master radio, uncheck the **Enable Roaming** option, and enter or select the

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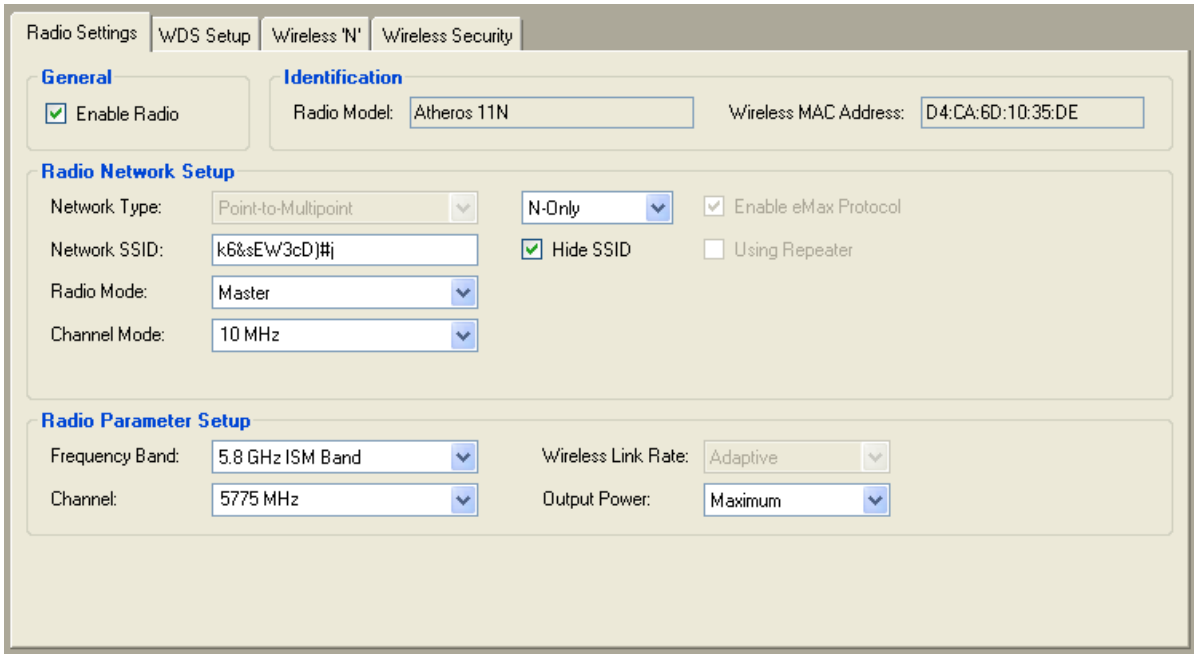
	MAC address of the master radio in the **Parent Radio MAC Address** field. This will prevent the remote radio from connecting to an unauthorized master radio that is placed in the vicinity of the remote.

6. If you follow all of the guidelines, the **Radio Settings** sub-tab for a master radio will look similar to the following example:



7. If you are securing a dual radio, select the **Radio 2** tab, and the **Radio Settings** sub-tab, and then repeat steps 5-6.

8. Press the **OK** button to save the new radio settings.

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Radio Settings (A and B/G Cards)

This topic describes the radio settings used to secure Broadband and Point-to-Multipoint radios using legacy B/G (2.4 GHz) or A (4.9 and 5.8 GHz) radio cards.

To configure Broadband and Point-to-Multipoint radios with secure settings:

1. Run ENCOM STRATOS to access your network.
2. Select the radio you want to secure.
3. Select **Radio -> Configure** from the main menu. (Alternatively, just double-click the radio.)
4. Select the **Radio 1** tab, and the **Radio Settings** sub-tab.
5. Update the settings using the following guidelines:

Setting	Guideline
Network SSID	Use an innocuous word or phrase, or a random combination of letters, numbers and punctuation (except for the $, \ and " characters). This prevents someone that discovers the network from easily determining the type of radios in the network, who the network belongs to, or what the network is being used for.
Hide SSID	Check this option to prevent the network SSID from being broadcast. This will prevent unauthorized client devices from detecting your network, and will prevent casual discovery of your network. If client devices are allowed to connect to the network, they will have to be manually configured with the SSID.
Allow Clients	If you don't need to support wireless client devices, leave this setting unchecked. This prevents client devices from being able to connect to the radio, making your network harder to compromise.
Channel Mode	Most A/B/G client devices can only detect networks that are using the 20 MHz channel mode. If you do not need to support client devices, you can set the channel mode to 5 MHz, 10 MHz or 40 MHz. This will prevent casual discovery of your network.
Channel	If using a 5.8 GHz radio, and you do not need to support client

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	devices, set the channel to a frequency that is not supported by client devices. This will prevent unauthorized devices from being able to detect your network. The following is a list of the 5.8 GHz band frequencies that are normally supported by client devices in North America: • 5180 MHz • 5200 MHz • 5220 MHz • 5240 MHz • 5745 MHz • 5765 MHz • 5785 MHz • 5805 MHz • 5825 MHz If using a 2.4 GHz radio, all of the available frequencies are supported by client devices. If using a 4.9 GHz radio, none of the available frequencies are supported by regular client devices (specialized 4.9 GHz client devices do exist).
Enable eMax Protocol	eMax is a proprietary protocol that increases the bandwidth of the wireless links. Since the protocol is not compatible with standard client devices, these devices will not be able to connect to a network that is using the eMax protocol.
Enable Roaming	If the radio is configured as a remote, it will by default connect to any compatible master radio it detects. To force the remote radio to connect to a specific master radio, uncheck the **Enable Roaming** option, and enter or select the MAC address of the master radio in the **Parent Radio MAC Address** field. This will prevent the remote radio from connecting to an unauthorized master radio that is placed in the vicinity of the remote.

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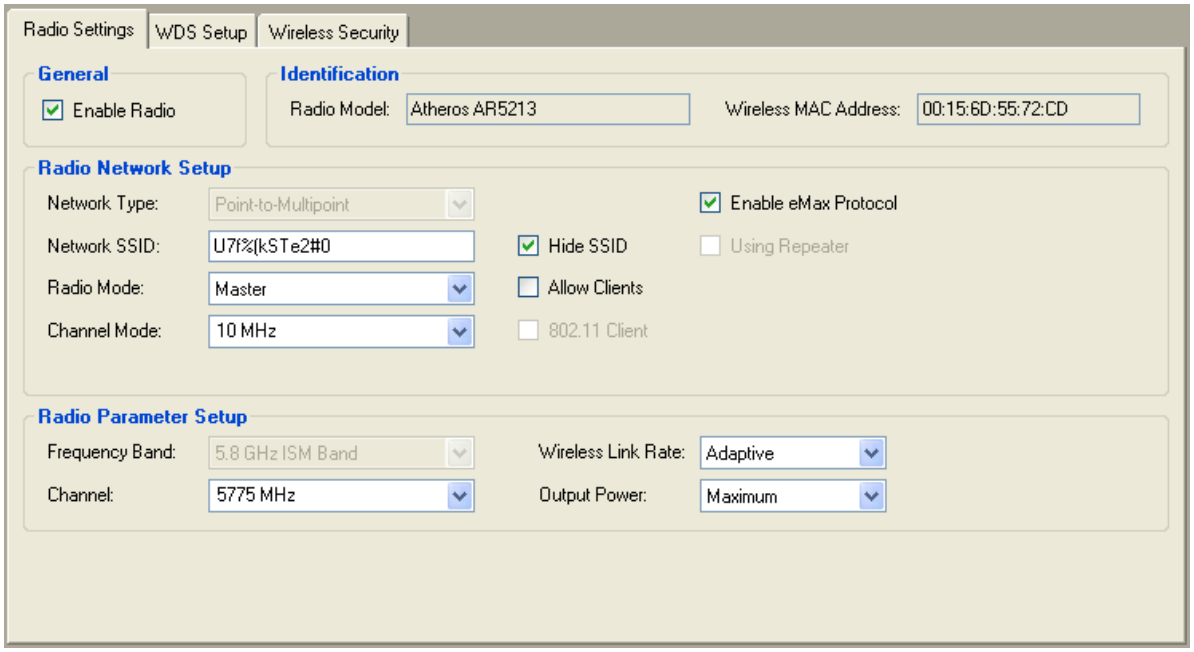
6. If you follow all of the guidelines, the **Radio Settings** sub-tab for a master radio will look similar to the following example:



7. If you are securing a dual radio, select the **Radio 2** tab, and the **Radio Settings** sub-tab, and then repeat steps 5-6.

8. Press the **OK** button to save the new radio settings.

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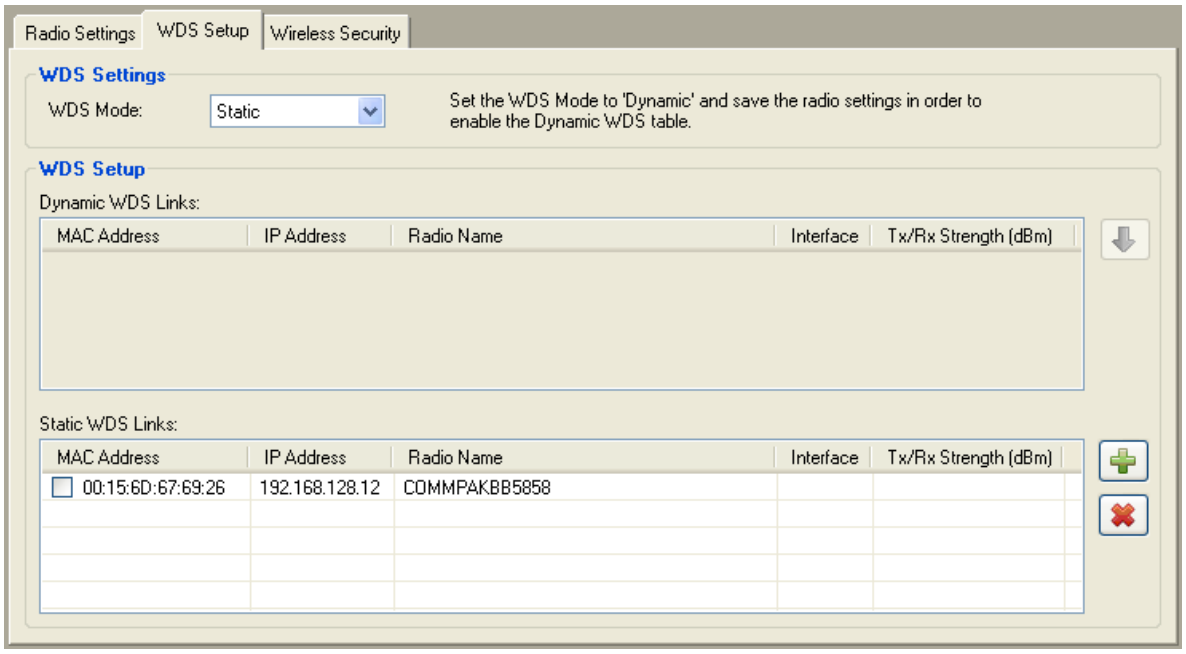
WDS Settings

This topic describes the WDS settings used to secure Broadband and Point-to-Multipoint radios.

To configure Broadband and Point-to-Multipoint radios with secure settings:

1. Run ENCOM STRATOS to access your network.
2. Select the radio you want to secure.
3. Select **Radio -> Configure** from the main menu. (Alternatively, just double-click the radio.)
4. Select the **Radio 1** tab, and the **WDS Setup** sub-tab.
5. Move the appropriate **Dynamic WDS Links** to the **Static WDS Links** table.
6. Change the **WDS Mode** setting to **Static**.
7. If you follow all of the guidelines, the **WDS Setup** sub-tab will look similar to the following example:



8. If you are securing a dual radio, select the **Radio 2** tab, and the **WDS Setup** sub-tab, and then repeat steps 5-7.
9. Press the **OK** button to save the new radio settings.

NOTE	WDS settings only apply to master and repeater radios. For remote radios, the wireless connection can be secured by disabling roaming and setting the parent

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MAC address. See the Radio Settings (N Cards) or Radio Settings (A and B/G Cards) topic for more information.

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Wireless Security Settings (N Cards)

This topic describes the wireless security settings used to secure Broadband and Point-to-Multipoint radios using Wireless-N radio cards.

To configure Broadband and Point-to-Multipoint radios with secure settings:

1. Run ENCOM STRATOS to access your network.
2. Select the radio you want to secure.
3. Select **Radio -> Configure** from the main menu. (Alternatively, just double-click the radio.)
4. Select the **Radio 1** tab, and the **Wireless Security** sub-tab.
5. If you have selected the **N-Only** option in the Network Type option in the Radio Settings tab, update the settings using the following guidelines:

Setting	Guideline
Wireless Security Type	Select the **Dynamic** option.
Pre-Shared Key	Enter the password used to secure the wireless links. The password should be at least 8 characters long (12 to 16 is preferable), and contain a random combination of upper and lowercase letters, numbers and punctuation characters (except for the $ and “ characters).

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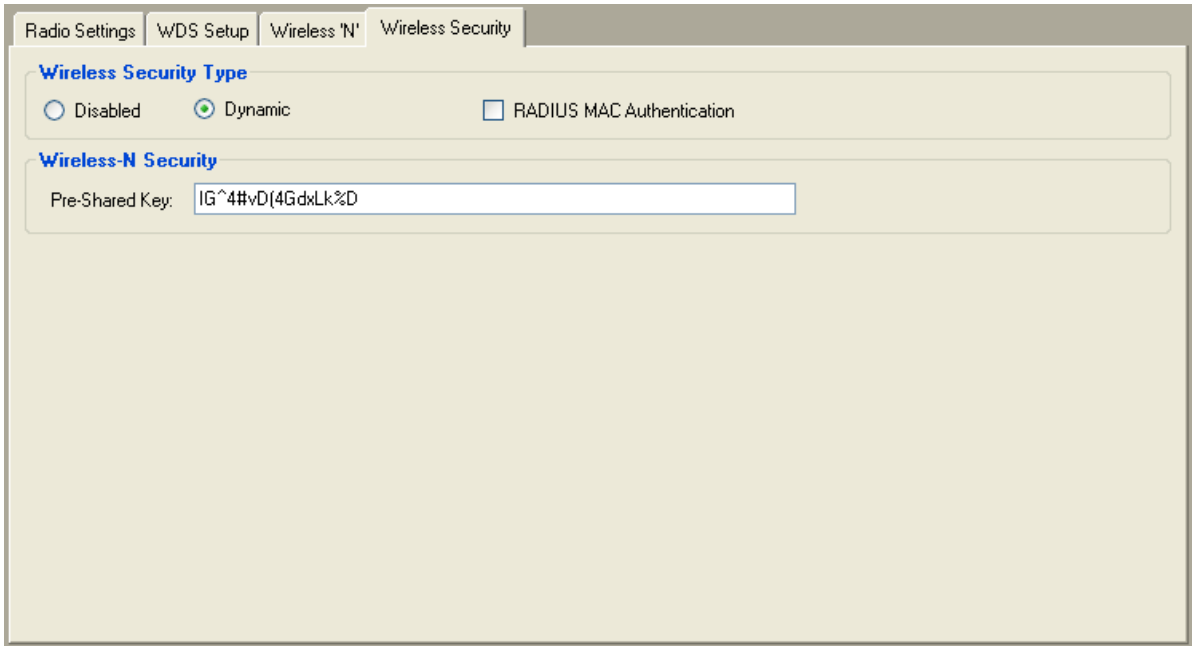
6. If you follow all of the guidelines, the **Wireless Security** sub-tab will look similar to the following example:



7. If you have selected the **A-Only, A/N Clients, G-Only or B/G/N Clients** option in the Network Type option in the Radio Settings tab, update the settings using the following guidelines:

Setting	Guideline
Wireless Security Type	Select the **Dynamic** option. Static key based security (especially WEP) is no longer considered secure, and should only be used if client devices that don't support WPA or WPA2 security must connect to the radio.
WPA Personal	Leave unchecked, unless client devices that support WPA but don't support WPA2 security must connect to the radio.
WPA Personal Pre-Shared Key	If the **WPA Personal** option is checked, enter a strong password in the **WPA Personal Pre-Shared Key** field. The password should be at least 8 characters long (12 to 16 is preferable), and contain a random combination of upper and lowercase letters, numbers and punctuation characters (except for the $ and “ characters).
WPA2 Personal	Check this option. WPA2 Personal is the most secure option that

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	can be easily set up and managed.
WPA2 Personal Personal Pre-Shared Key	If the **WPA2 Personal** option is checked, enter a strong password in the **WPA2 Personal Pre-Shared Key** field. The password should be at least 8 characters long (12 to 16 is preferable), and contain a random combination of upper and lowercase letters, numbers and punctuation characters (except for the $ and " characters).
WPA Enterprise	Unless you have set up the IT infrastructure that supports WPA Enterprise, leave this option unchecked.
WPA2 Enterprise	Unless you have set up the IT infrastructure that supports WPA2 Enterprise, leave this option unchecked.
Unicast Ciphers, TKIP	Leave unchecked, unless client devices that support WPA but don't support WPA2 security must connect to the radio.
Unicast Ciphers, AES-CCM	Check this option, as it is the most secure encryption algorithm supported by the radio.
Group Ciphers, TKIP	Leave unchecked, unless client devices that support WPA but don't support WPA2 security must connect to the radio.
Group Ciphers, AES-CCM	Check this option, as it is the most secure encryption algorithm supported by the radio.
Group Key Update Time	Leave at 5 minutes.

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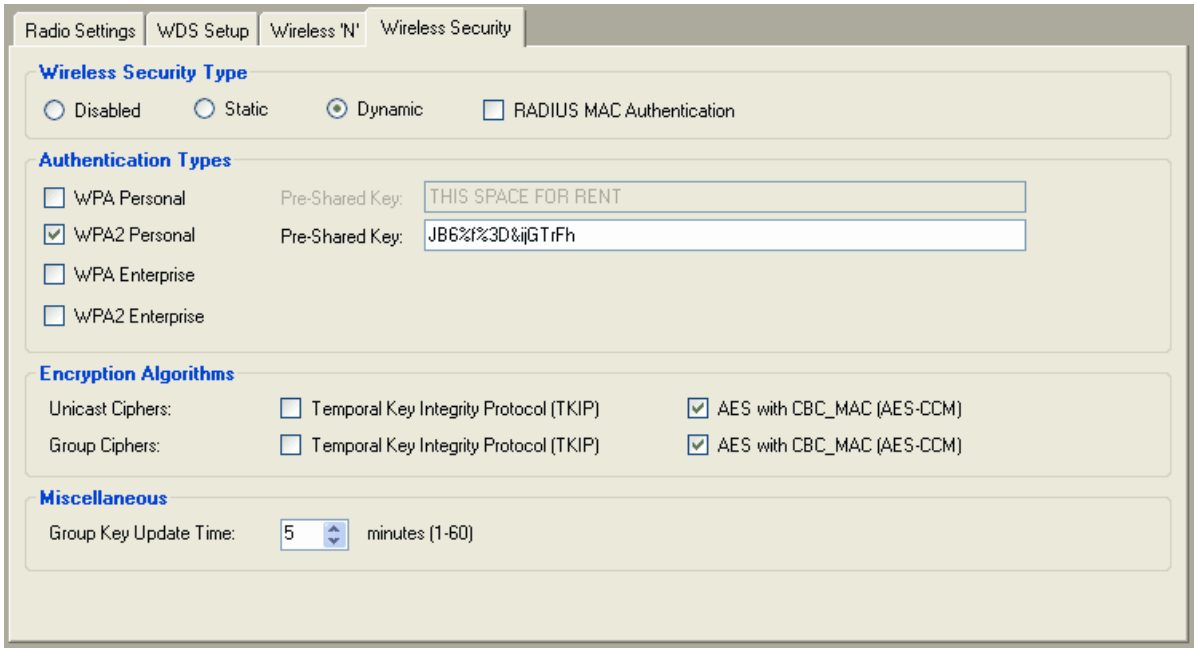
8. If you follow all of the guidelines, the **Wireless Security** sub-tab will look similar to the following example:



9. If you are securing a dual radio, select the **Radio 2** tab, and the **Wireless Security** sub-tab, and then repeat steps 5-8.

10. Press the **OK** button to save the new radio settings.

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Wireless Security Settings (A and B/G Cards)

This topic describes the wireless security settings used to secure Broadband and Point-to-Multipoint radios using legacy B/G (2.4 GHz) or A (4.9 and 5.8 GHz) radio cards.

To configure Broadband and Point-to-Multipoint radios with secure settings:

1. Run ENCOM STRATOS to access your network.
2. Select the radio you want to secure.
3. Select **Radio -> Configure** from the main menu. (Alternatively, just double-click the radio.)
4. Select the **Radio 1** tab, and the **Wireless Security** sub-tab.
5. Update the settings using the following guidelines:

Setting	Guideline
Wireless Security Type	Select the **Dynamic** option. Static key based security (especially WEP) is no longer considered secure, and should only be used if client devices that don't support WPA or WPA2 security must connect to the radio.
WPA Personal	Leave unchecked, unless client devices that support WPA but don't support WPA2 security must connect to the radio.
WPA Personal Pre-Shared Key	If the **WPA Personal** option is checked, enter a strong password in the **WPA Personal Pre-Shared Key** field. The password should be at least 8 characters long (12 to 16 is preferable), and contain a random combination of upper and lowercase letters, numbers and punctuation characters (except for the $ and “ characters).
WPA2 Personal	Check this option. WPA2 is the most secure option that can be easily set up and managed.
WPA2 Personal Pre-Shared Key	If the **WPA2 Personal** option is checked, enter a strong password in the **WPA2 Personal Pre-Shared Key** field. The password should be at least 8 characters long (12 to 16 is preferable), and contain a random combination of upper and lowercase letters, numbers and punctuation characters (except for the $ and “ characters).
WPA Enterprise	Unless you have set up the IT infrastructure that supports WPA Enterprise, leave this option unchecked.

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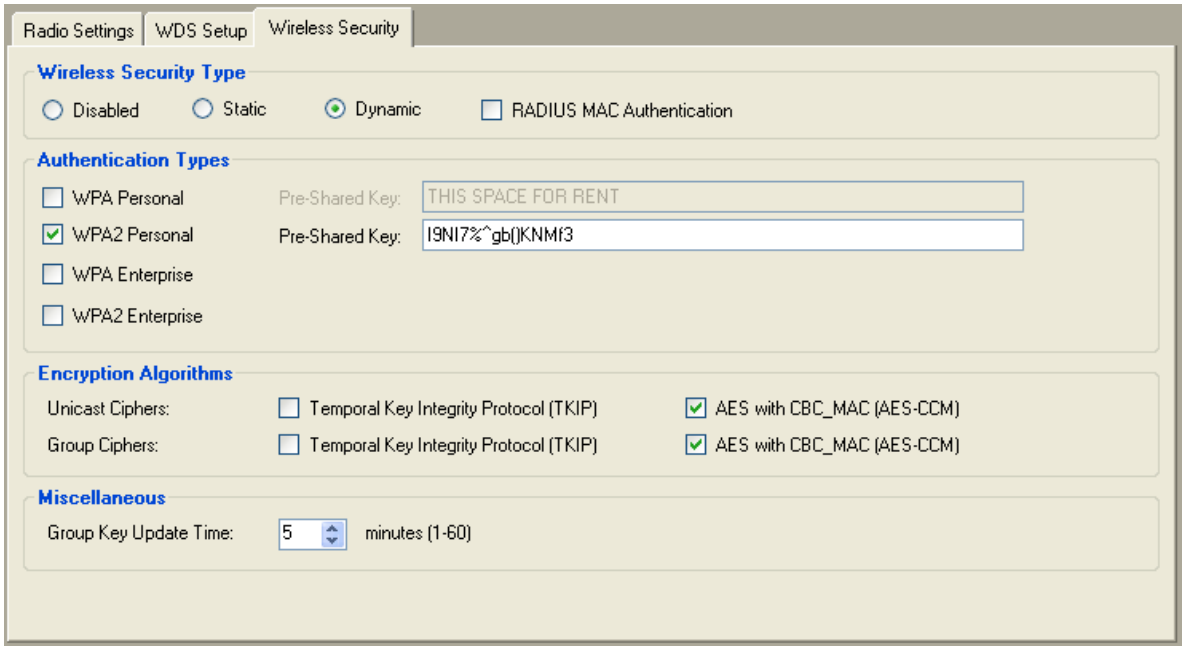
WPA2 Enterprise	Unless you have set up the IT infrastructure that supports WPA2 Enterprise, leave this option unchecked.
Unicast Ciphers, TKIP	Leave unchecked, unless client devices that support WPA but don't support WPA2 security must connect to the radio.
Unicast Ciphers, AES-CCM	Check this option, as it is the most secure encryption algorithm supported by the radio.
Group Ciphers, TKIP	Leave unchecked, unless client devices that support WPA but don't support WPA2 security must connect to the radio.
Group Ciphers, AES-CCM	Check this option, as it is the most secure encryption algorithm supported by the radio.
Group Key Update Time	Leave at 5 minutes.

6. If you follow all of the guidelines, the **Wireless Security** sub-tab will look similar to the following example:



7. If you are securing a dual radio, select the **Radio 2** tab, and the **Wireless Security** sub-tab, and then repeat steps 5-6.

8. Press the **OK** button to save the new radio settings.

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Mesh radios

Radio Settings (Mesh Radios)

This topic describes the radio settings used to secure ENCOM mesh radios.

To configure mesh radios with secure settings:

1. Run ENCOM STRATOS to access your network.
2. Select the radio you want to secure.
3. Select **Radio -> Configure** from the main menu. (Alternatively, just double-click the radio.)
4. Select the **Radio 1** tab, and the **Radio Settings** sub-tab.
5. Update the settings using the following guidelines:

Setting	Guideline
Network Type	If you don't need to support wireless client devices (e.g. laptops, smart-phones, wireless cameras), set this option to **Mesh-Only.** This prevents client devices from being able to connect to the radio, making your network harder to compromise.
Network SSID	Use an innocuous word or phrase, or a random combination of letters, numbers and punctuation (except for the $, \ and " characters). This prevents someone that discovers the network from easily determining the type of radios in the network, who the network belongs to, or what the network is being used for.
Hide SSID	Check this option to prevent the network SSID from being broadcast. This will prevent unauthorized client devices from detecting your network, and will prevent casual discovery of your network. If client devices are allowed to connect to the network, they will have to be manually configured with the SSID.
Channel Mode	Most wireless-N client devices can only detect networks that are using 20 MHz or 40 MHz channel modes, and most A/B/G client devices can only detect networks that are using the 20 MHz channel mode. If you do not need to support client devices, and your network does not need to handle a high amount of network traffic, you

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	can set the channel mode to 5 MHz or 10 MHz. This will prevent casual discovery of your network. For A/B/G radios, use the 40 MHz mode for both security and maximum bandwidth.
Channel	If using a 5.8 GHz radio, and you do not need to support client devices, set the channel to a frequency that is not supported by client devices. This will prevent unauthorized devices from being able to detect your network. The following is a list of the 5.8 GHz band frequencies that are normally supported by client devices in North America: • 5180 MHz • 5200 MHz • 5220 MHz • 5240 MHz • 5745 MHz • 5765 MHz • 5785 MHz • 5805 MHz • 5825 MHz If using a 2.4 GHz radio, all of the available frequencies are supported by client devices. If using a 4.9 GHz radio, none of the available frequencies are supported by regular client devices (specialized 4.9 GHz client devices do exist).

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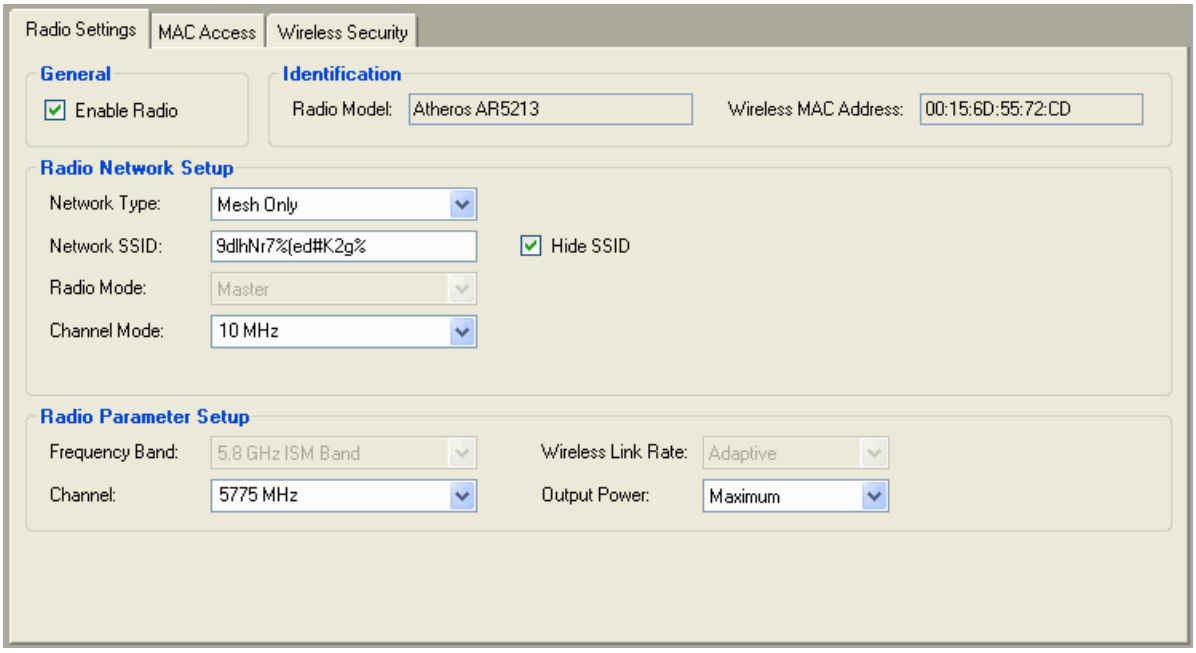
6. If you follow all of the guidelines, the **Radio Settings** sub-tab for a mesh radio will look similar to the following example:



7. If you are securing a dual radio, select the **Radio 2** tab, and the **Radio Settings** sub-tab, and then repeat steps 5-6.

8. Press the **OK** button to save the new radio settings.

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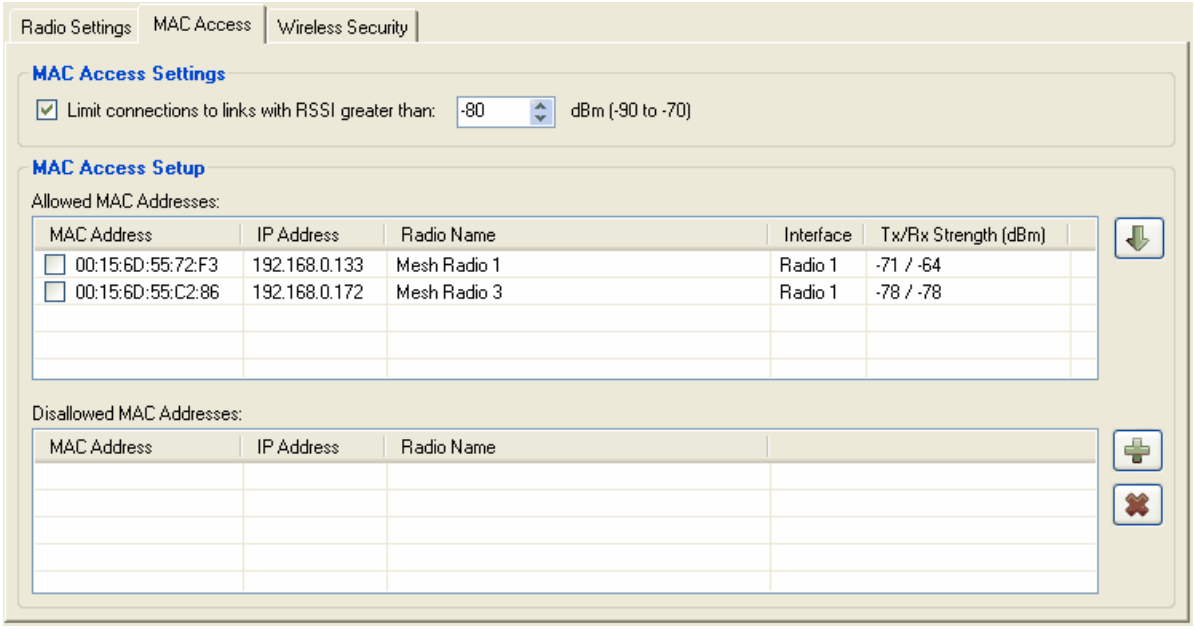
MAC Access Settings

Unlike Broadband or Point-to-Multipoint radios, there is no explicit way to prevent one mesh radio from connecting to another mesh radio.

As long as the radios are provisioned with the same Network SSID, Channel mode, Channel (frequency) and wireless security settings, they will be able to connect with each other (which is the point of a mesh network).

The following example shows the MAC Access settings for a typical mesh radio:



You are able to specify the minimum signal strength required for a connection to be established, and you can disallow specific radios from being able to connect to the radio. These features are used to preventing unwanted connections from developing between the radios that are part of the mesh network.

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Wireless Security Settings

This topic describes the wireless security settings used to secure mesh radios.

To configure mesh radios with secure settings:

1. Run ENCOM STRATOS to access your network.
2. Select the radio you want to secure.
3. Select **Radio -> Configure** from the main menu. (Alternatively, just double-click the radio.)
4. Select the **Radio 1** tab, and the **Wireless Security** sub-tab.
5. Update the settings using the following guidelines:

Setting	Guideline
Wireless Security Type	Select the **Dynamic** option. Static key based security (especially WEP) is no longer considered secure, and should only be used if client devices that don't support WPA or WPA2 security must connect to the radio.
WPA Personal	Leave unchecked, unless client devices that support WPA but don't support WPA2 security must connect to the radio.
WPA Personal Pre-Shared Key	If the **WPA Personal** option is checked, enter a strong password in the **WPA Personal Pre-Shared Key** field. The password should be at least 8 characters long (12 to 16 is preferable), and contain a random combination of upper and lowercase letters, numbers and punctuation characters (except for the $ and “ characters).
WPA2 Personal	Check this option. WPA2 Personal is the most secure option that can be easily set up and managed.
WPA2 Personal Pre-Shared Key	If the **WPA2 Personal** option is checked, enter a strong password in the **WPA2 Personal Pre-Shared Key** field. The password should be at least 8 characters long (12 to 16 is preferable), and contain a random combination of upper and lowercase letters, numbers and punctuation characters (except for the $ and “ characters).
WPA Enterprise	Unless you have set up the IT infrastructure that supports WPA Enterprise, leave this option unchecked.

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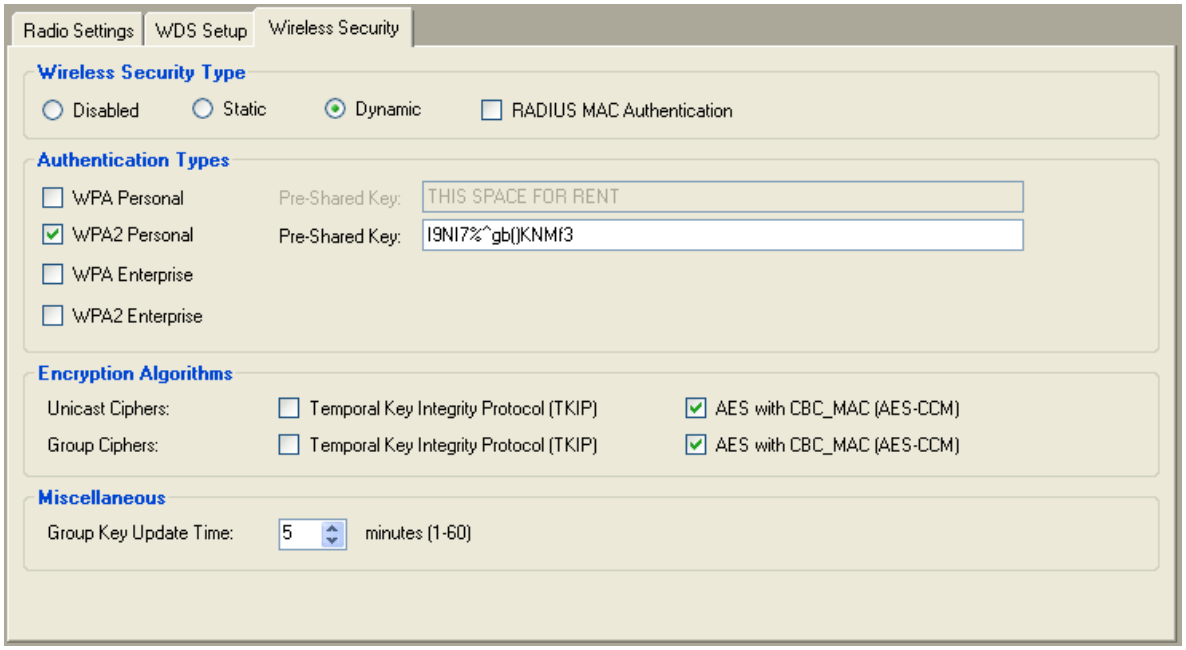
WPA2 Enterprise	Unless you have set up the IT infrastructure that supports WPA2 Enterprise, leave this option unchecked.
Unicast Ciphers, TKIP	Leave unchecked, unless client devices that support WPA but don't support WPA2 security must connect to the radio.
Unicast Ciphers, AES-CCM	Check this option, as it is the most secure encryption algorithm supported by the radio.
Group Ciphers, TKIP	Leave unchecked, unless client devices that support WPA but don't support WPA2 security must connect to the radio.
Group Ciphers, AES-CCM	Check this option, as it is the most secure encryption algorithm supported by the radio.
Group Key Update Time	Leave at 5 minutes.

6. If you follow all of the guidelines, the **Wireless Security** sub-tab will look similar to the following example:



7. If you are securing a dual radio, select the **Radio 2** tab, and the **Wireless Security** sub-tab, and then repeat steps 5-6.

8. Press the **OK** button to save the new radio settings.

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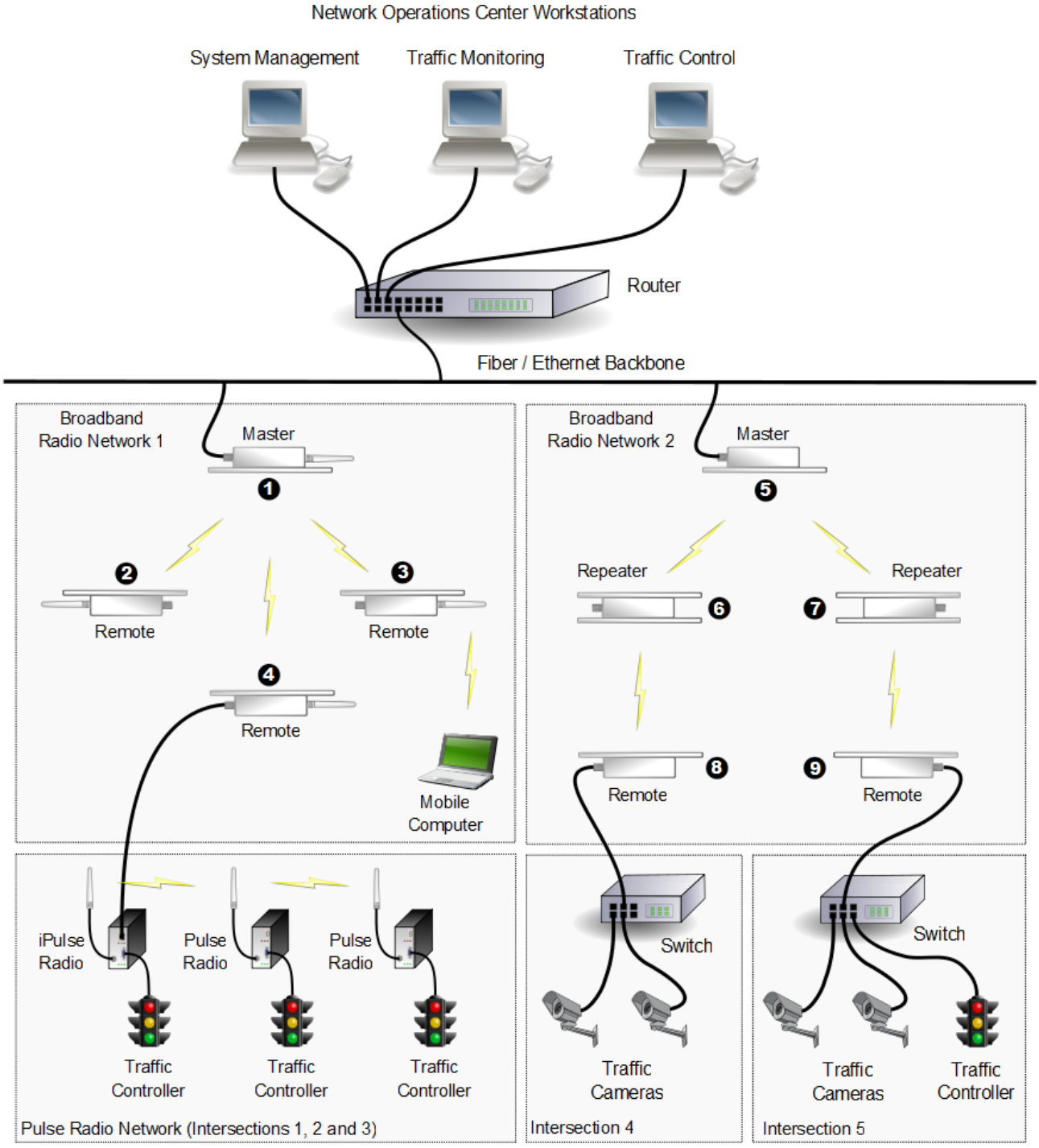
Detailed Security Example

The following diagram shows a typical system used to manage a traffic network. This section describes the security requirements for the two broadband radio networks, and provides configuration settings for each each radio. Although this is a simple example, all of the issues discussed can be applied to larger networks.



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The following table lists the MAC and IP addresses of the radios. These values are used in the example radio configurations that follow.

Radio Name	IP Address	Radio Card MAC Address
Broadband Radio Network 1		
Radio1	192.168.1.101	Radio Card 1 (2.4 GHz): **00:0D:B9:16:82:B0** Radio Card 2 (5.8 GHz): **04:CA:6D:45:EA:25**
Radio 2	192.168.1.102	Radio Card 1 (2.4 GHz): **00:0D:B9:86:14:BA** Radio Card 2 (5.8 GHz): **04:CA:6D:45:3B:4D**
Radio 3	192.168.1.103	Radio Card 1 (2.4 GHz): **00:0D:B9:17:51:43** Radio Card 2 (5.8 GHz): **04:CA:6D:23:04:53**
Radio 4	192.168.1.104	Radio Card 1 (2.4 GHz): **00:0D:B9:42:17:44** Radio Card 2 (5.8 GHz): **04:CA:6D:24:D3:2F**
Broadband Radio Network 2		
Radio 5	192.168.1.105	Radio Card 1 (5.8 GHz): **00:0D:F4:12:4A:3B**
Radio 6	192.168.1.106	Radio Card 1 (5.8 GHz): **00:0D:F4:2A:F3:4C**
Radio 7	192.168.1.107	Radio Card 1 (5.8 GHz): **00:0D:F4:87:C4:13**
Radio 8	192.168.1.108	Radio Card 1 (5.8 GHz): **00:0D:F4:12:4A:4C**
Radio 9	192.168.1.109	Radio Card 1 (5.8 GHz): **00:0D:F4:17:AC:35**

The following topics provide guidance on securing the networks that are composed of ENCOM broadband radios.

- Securing Broadband Network 1
- Securing Broadband Network 2

Refer to the *Encom PULSE Link User Guide* for information on securing the PULSE radio network.

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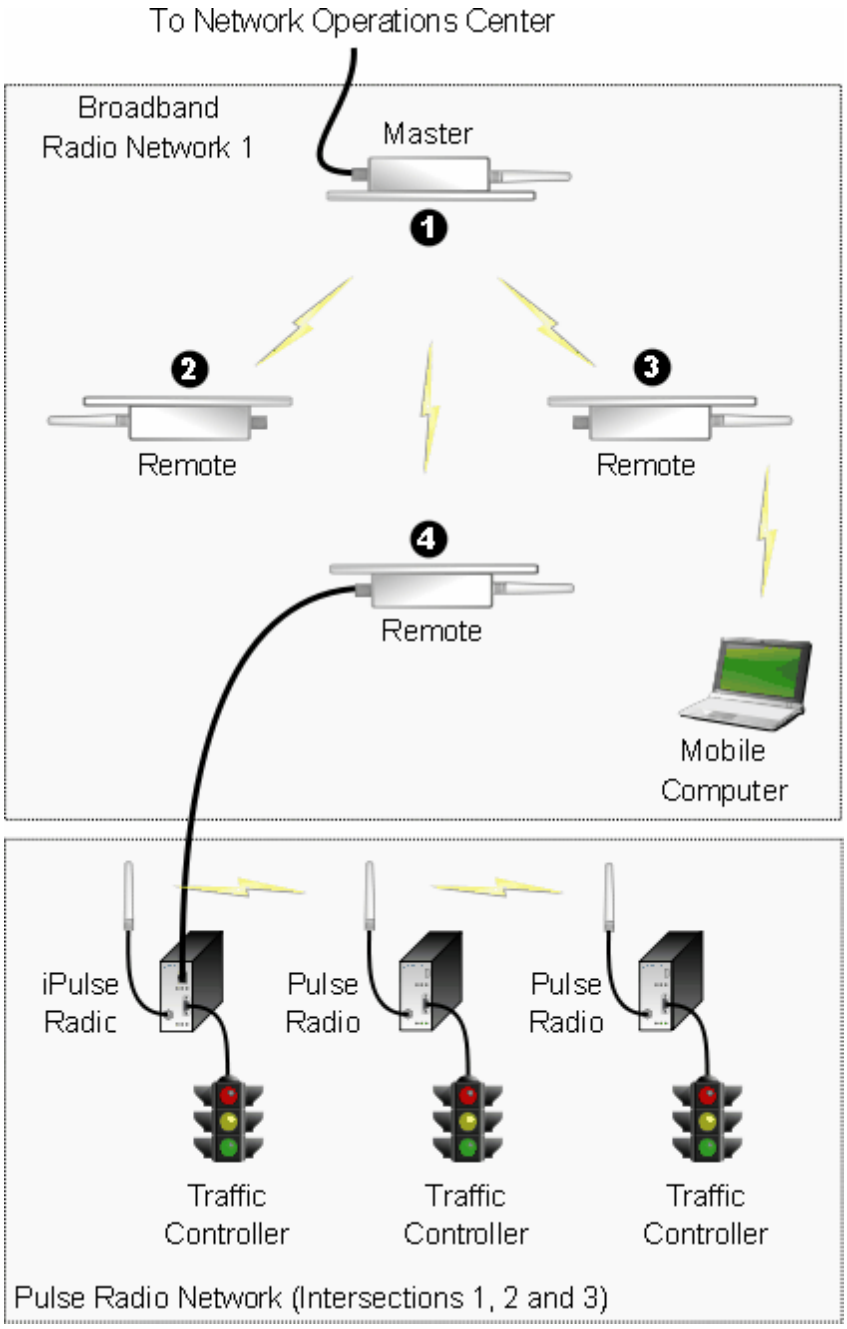
Securing Broadband Network 1

In this example, **Broadband Radio Network 1** consists of 4 "E-Lite INT 24/58" dual radios.

A single master radio (Radio 1) is directly connected to the Network Operations Center, and is wirelessly connected to three remote radios (Radio 2, Radio 3 and Radio 4). One of the remote radios (Radio 4) is connected to a 900 MHz PULSE radio network that provides communications for the traffic controllers.



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The 2.4 GHz radio cards (Radio 1) in the E-Lite radios are used for local wireless device access (for laptops, smart phones, etc.). They are connected to omnidirectional antennas for maximum local coverage. To simplify access to the 2.4 GHz network, all of the 2.4 GHz radios should be configured with the same **Network Type**, **Network SSID**, **Channel Mode** and **Wireless Security** settings. That way, a client device can connect to any of the 2.4 GHz radios in the network using a single connection profile.

The 5.8 GHz radio cards (Radio 2) in the E-Lite radios are used for the backbone of the network. They are connected to the integrated panel antenna for maximum signal range. In order for the radios in the 5.8 GHz network to communicate with each other, they must be configured with the same **Network Type**, **Network SSID**, **Channel Mode, eMax Protocol** and **Wireless Security** settings.

The configuration settings for each of the 4 radios are shown in the following topics:

- Master Radio (1)
- Remote Radios (2, 3 and 4)

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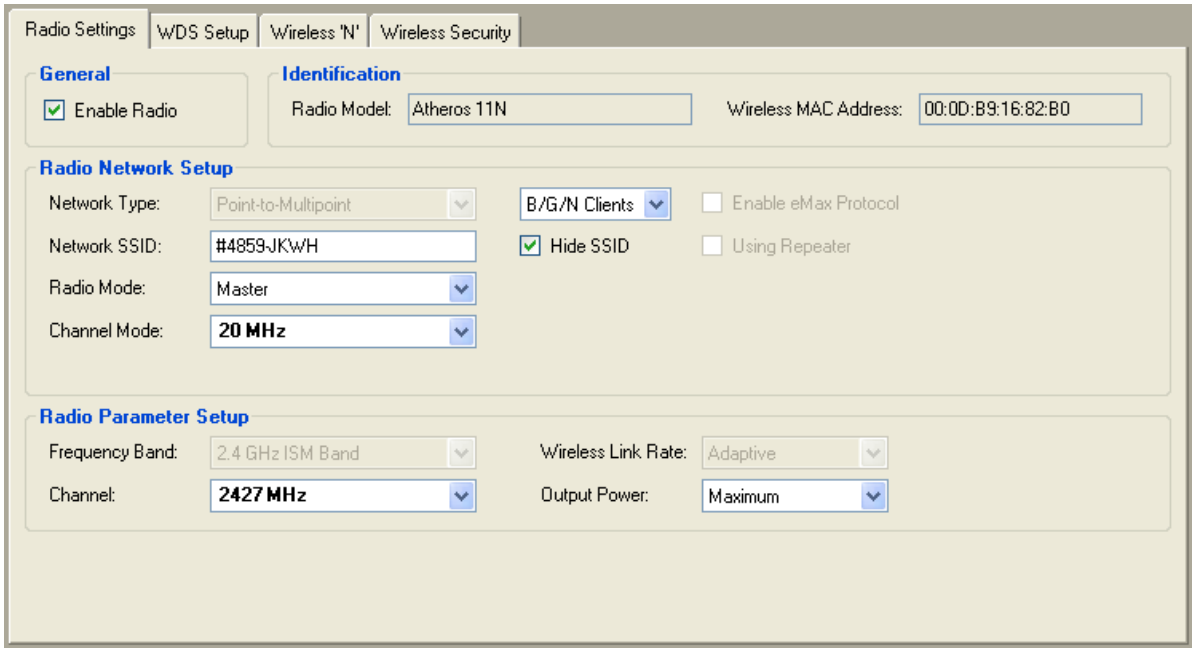
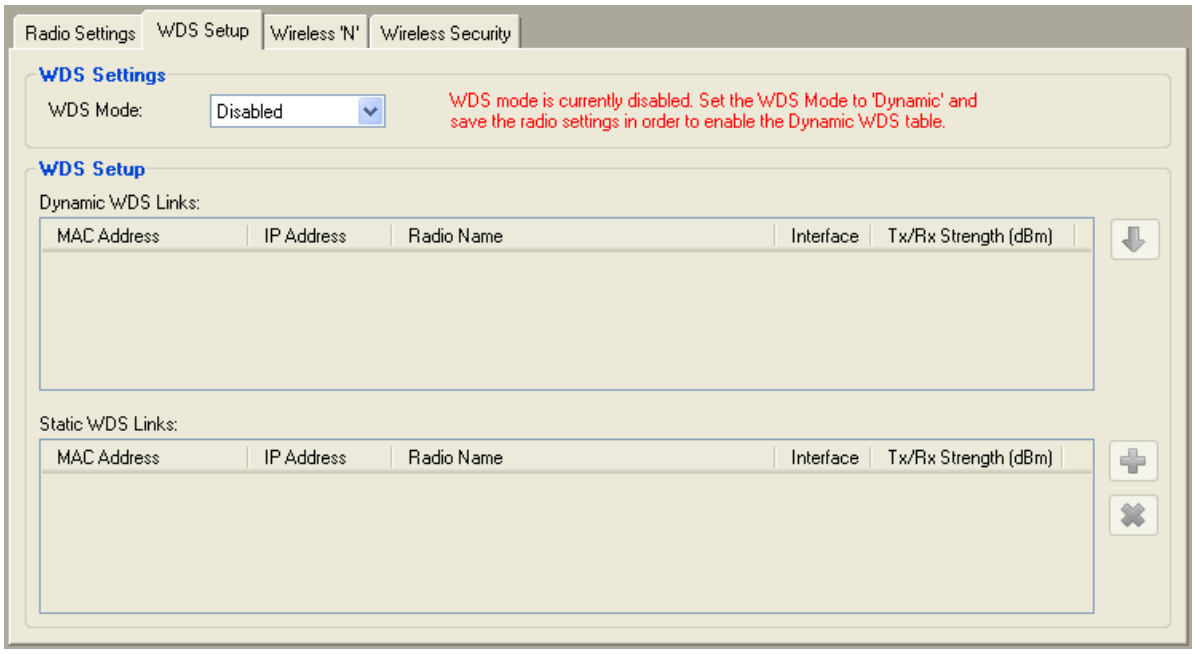
Master Radio (1)

The first (2.4 GHz) radio card of Master Radio 1 would be configured as follows.





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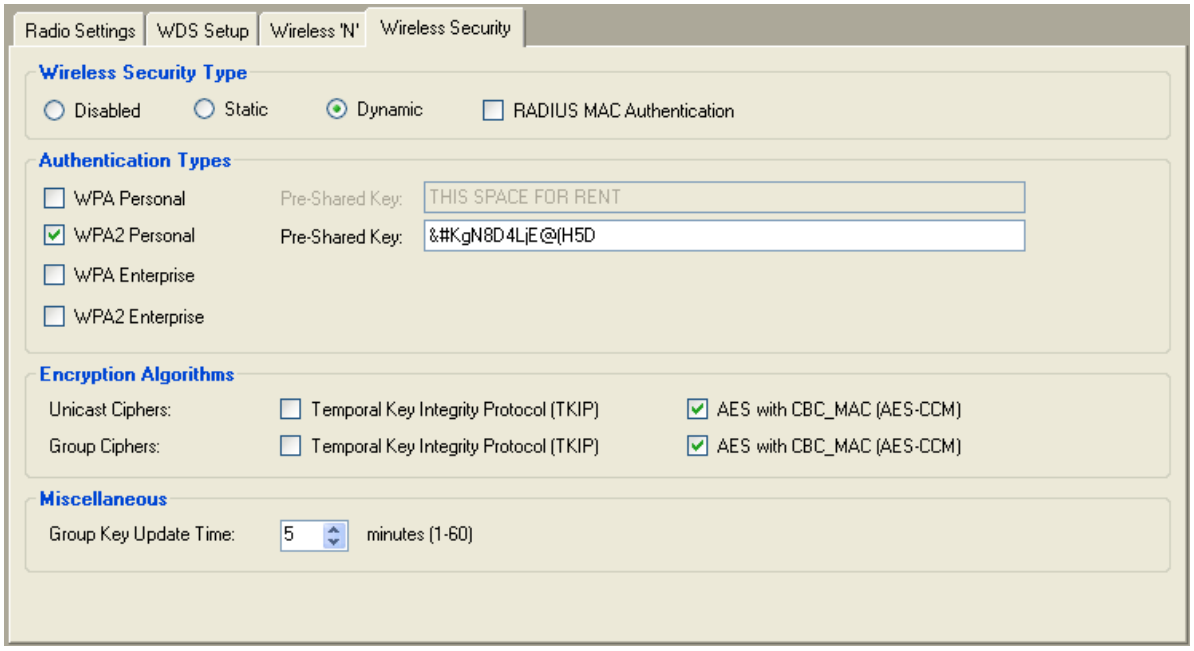
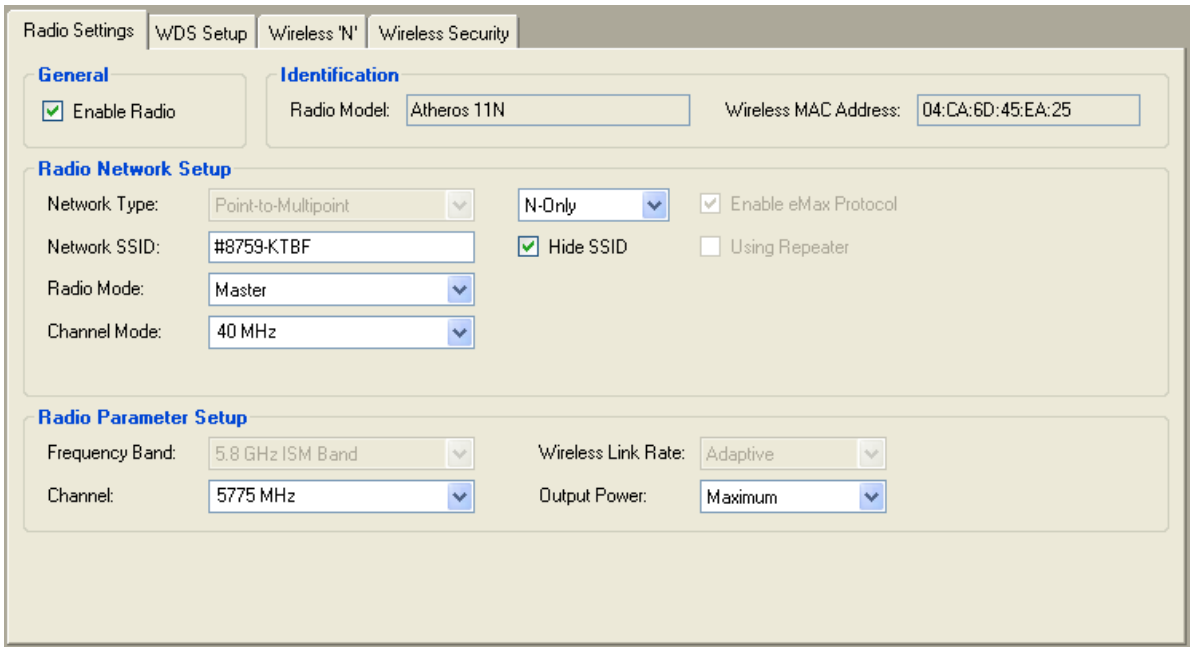


The second (5.8 GHz) radio card of Master Radio 1 would be configured as follows. Note that the WDS settings only allow the radio to connect to the three remotes that are part of the network.



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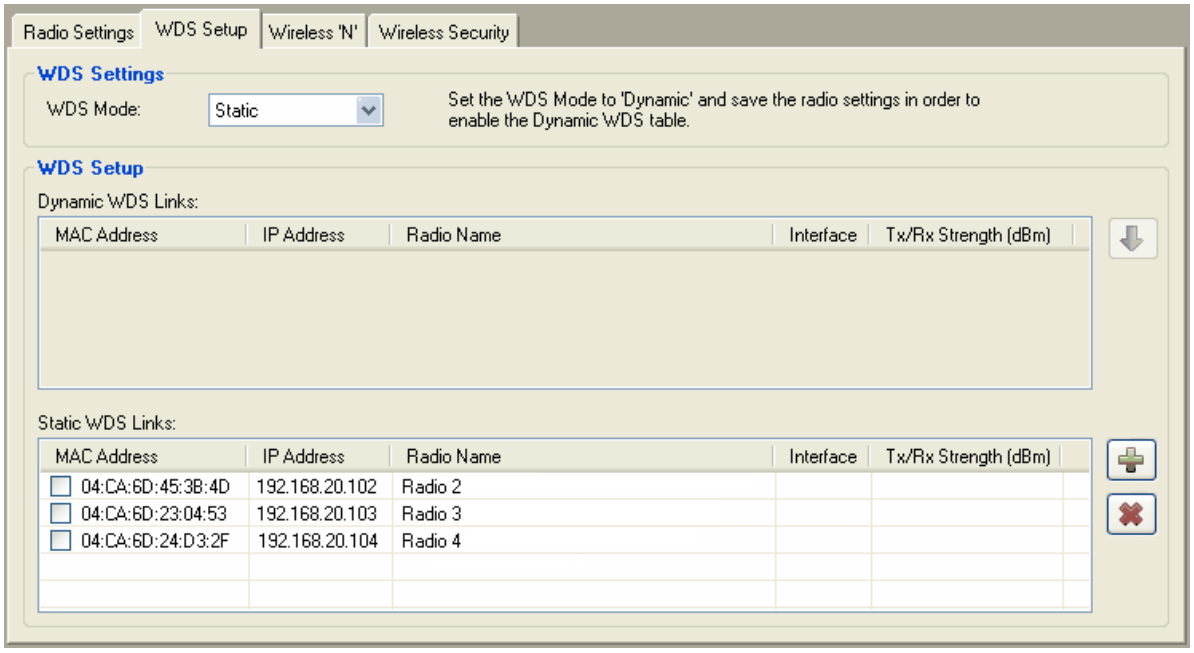

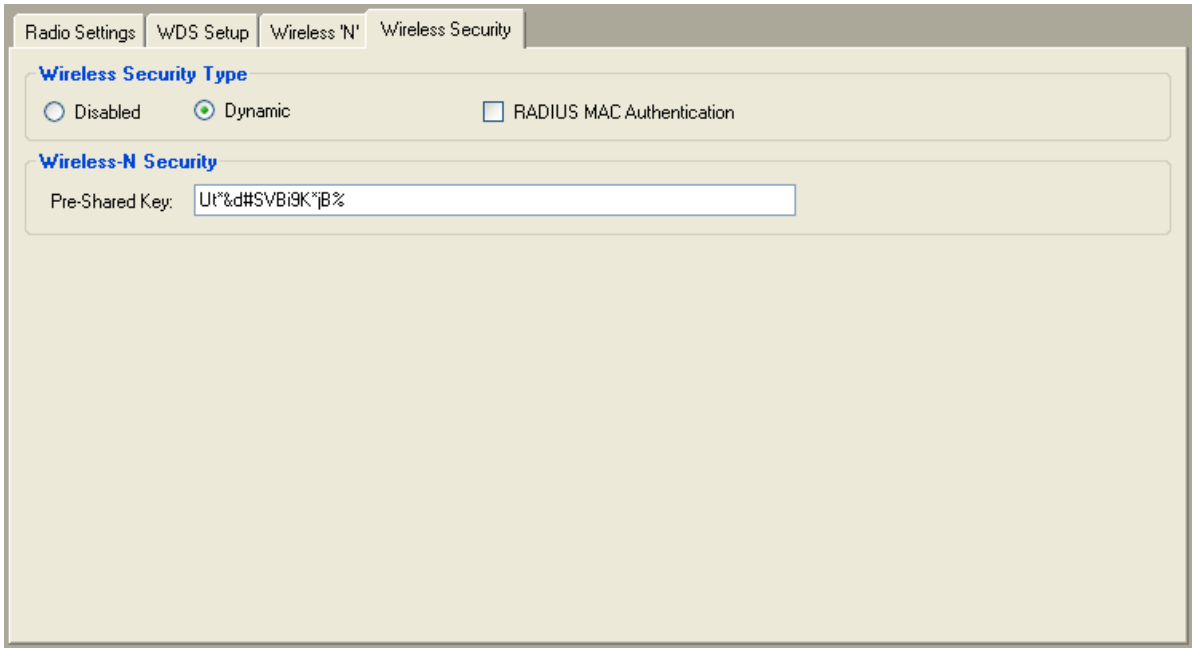

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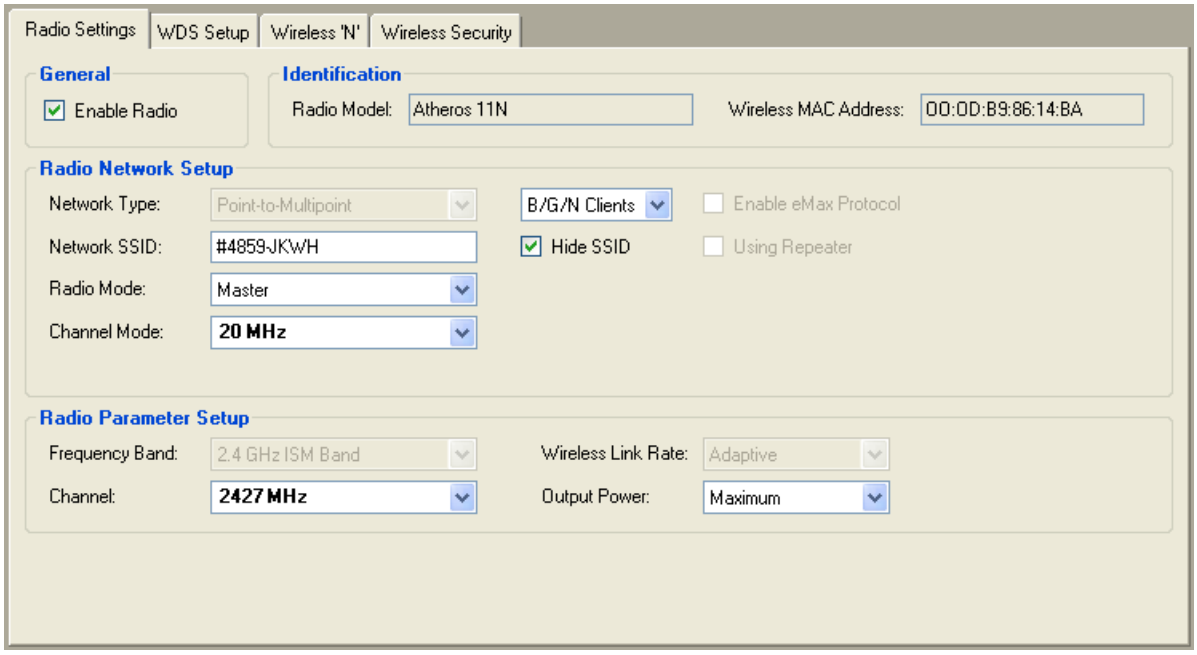
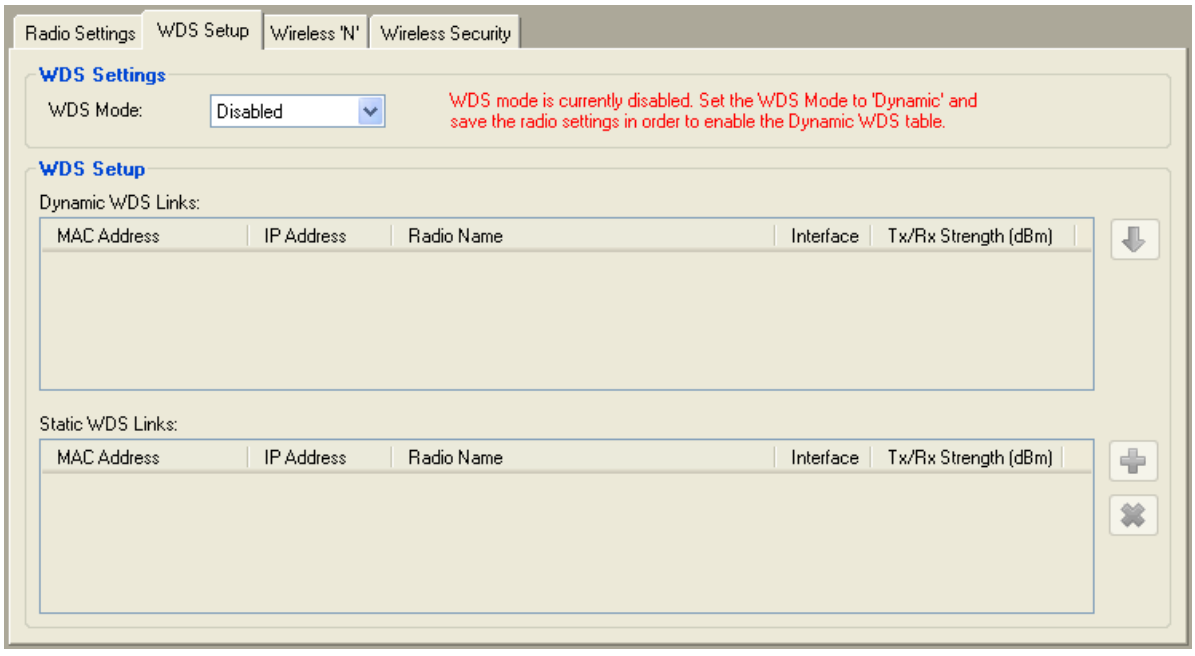
Remote Radios (2, 3 and 4)

The first (2.4 GHz) radio card of the remote radios would be configured as follows. This configuration is identical to that of the master radio.





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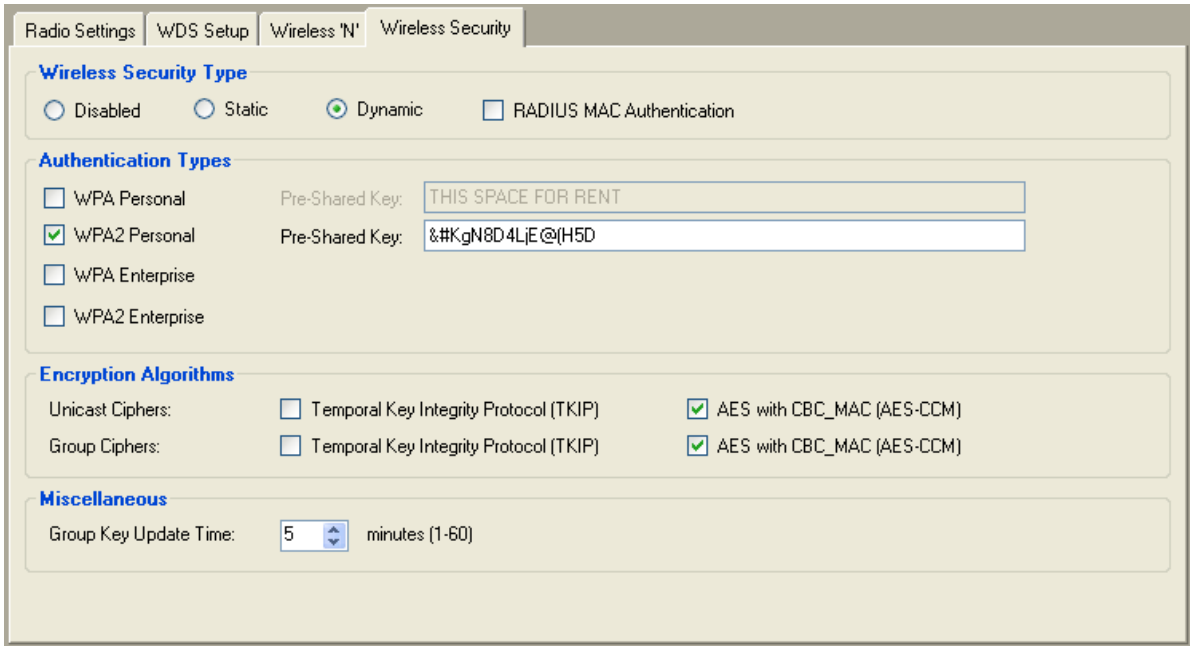
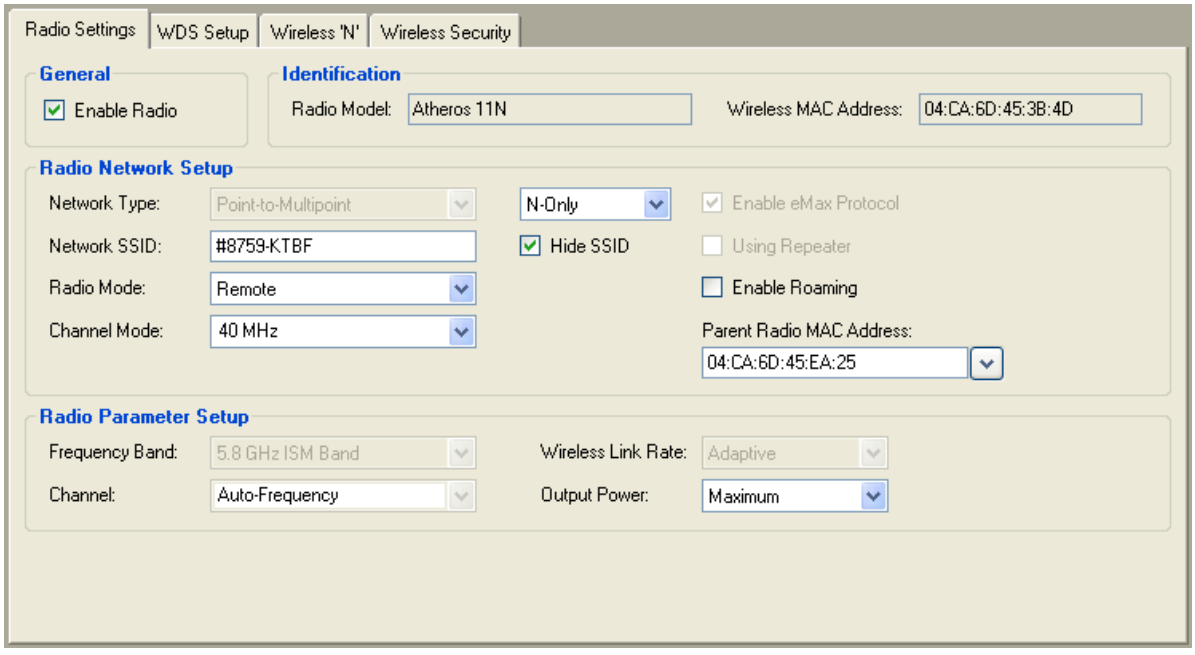


The second (5.8 GHz) radio card of the remote radios would be configured as follows.



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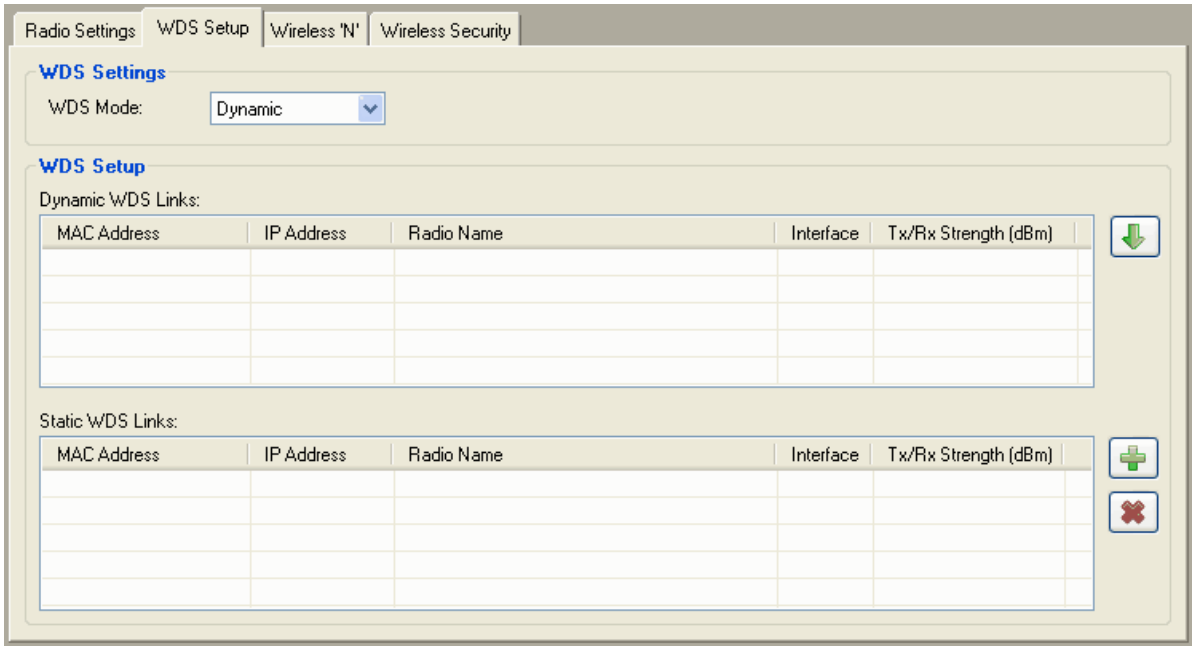

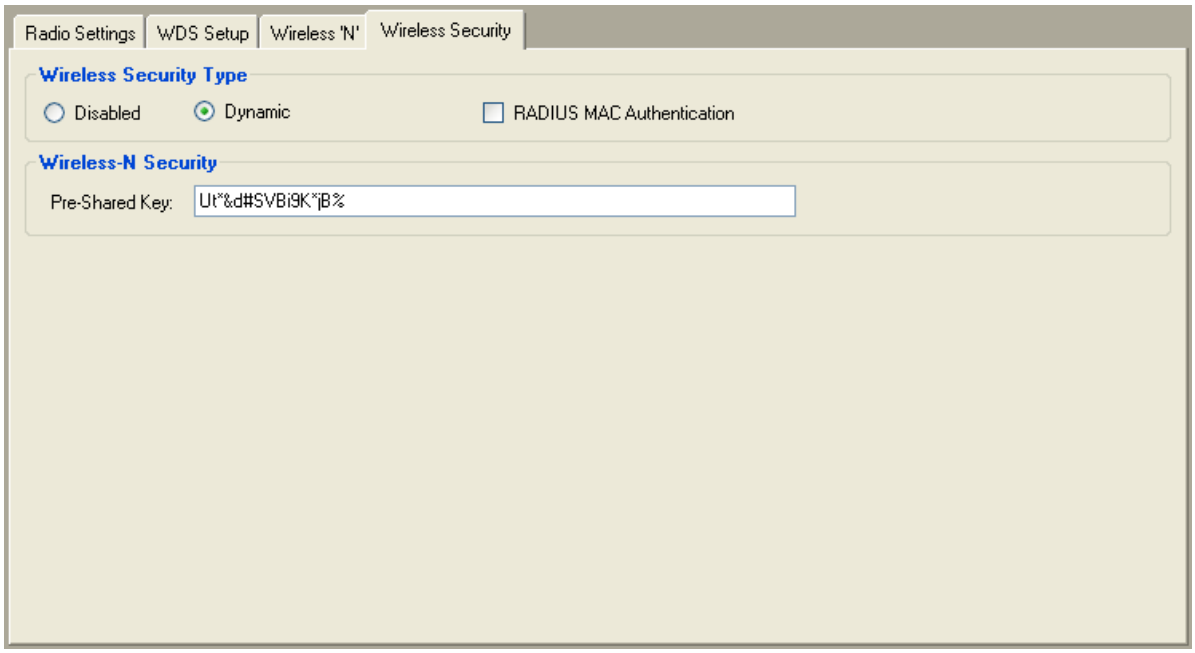

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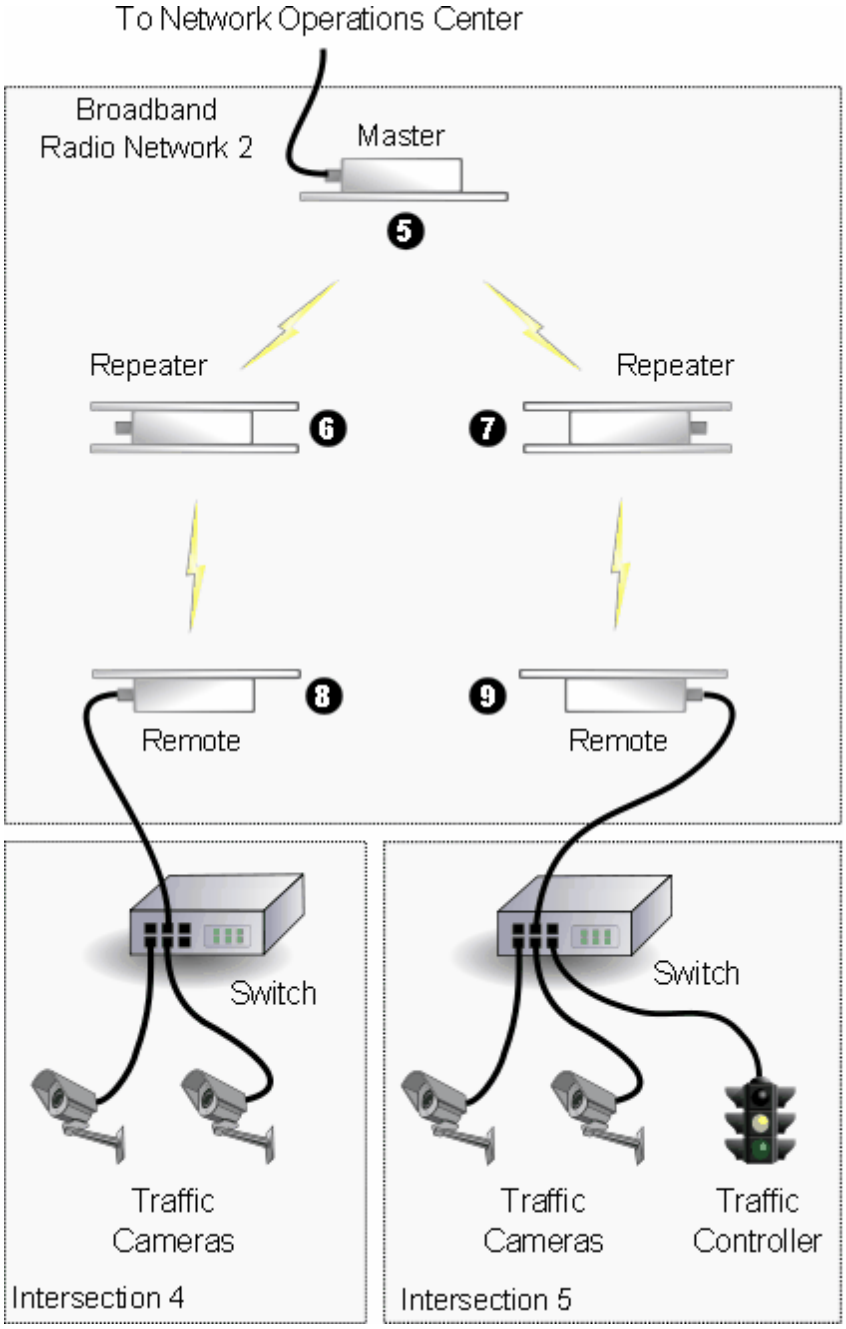
Securing Broadband Network 2

In this example, **Broadband Radio Network 2** consists of 5 "COMMPAKBB58" single radios. They form the communications backbone used to access devices such as traffic cameras and traffic controllers.



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A single master radio (Radio 5) is directly connected to the Network Operations Center. It is wirelessly connected to two repeater radios (Radio 6 and Radio 7), that are in turn wirelessly connected to two remote radios (Radio 8 and Radio 9). The remote radios are connected to switches to which traffic cameras and traffic controllers are connected.

The switches are configured to use VLANs to segregate the camera and traffic controller data. The radios are configured to use a management VLAN (see the VLAN Support topic for more information on configuring VLANs).

All of the radios use panel antennas to communicate with each other. Because they are part of the same network, they must be configured with the same **Network Type**, **Network SSID**, **Channel Mode, eMax Protocol** and **Wireless Security** settings. Because cameras typically generate a significant amount of traffic, the radios will be configured to maximize throughput.

The configuration settings for each of the 4 radios are shown in the following topics:

- Master Radio (5)
- Repeater Radio (6)
- Repeater Radio (7)
- Remote Radio (8)
- Remote Radio (9)

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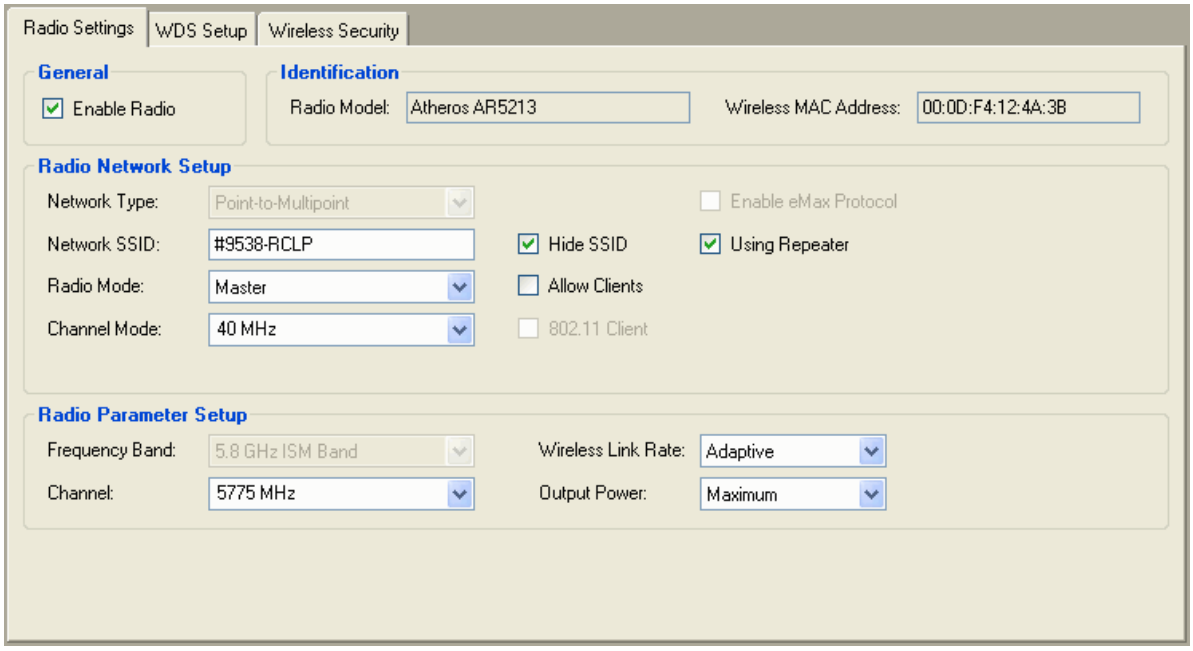
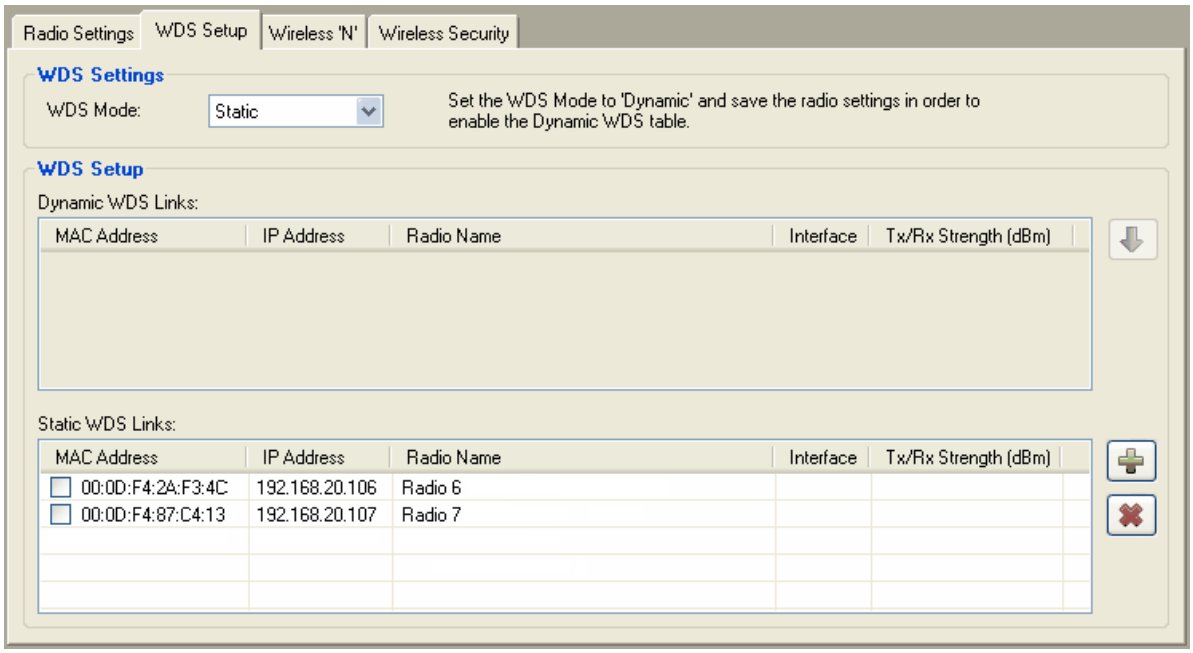
Master Radio (5)

Master Radio 5 would be configured as follows.





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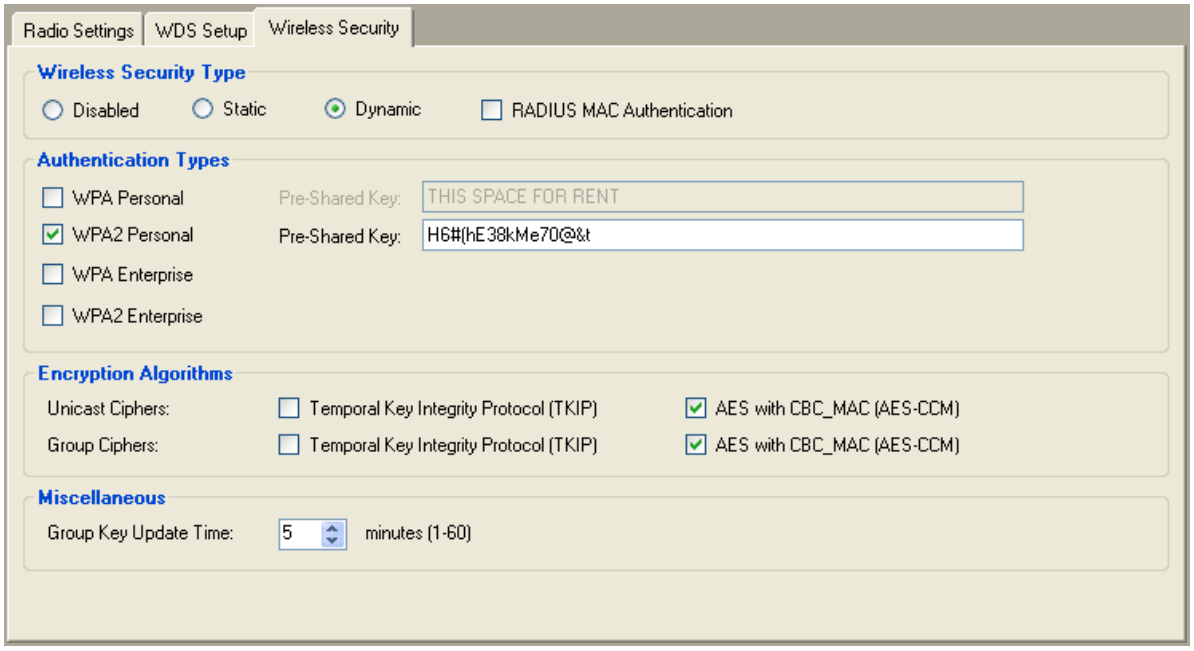

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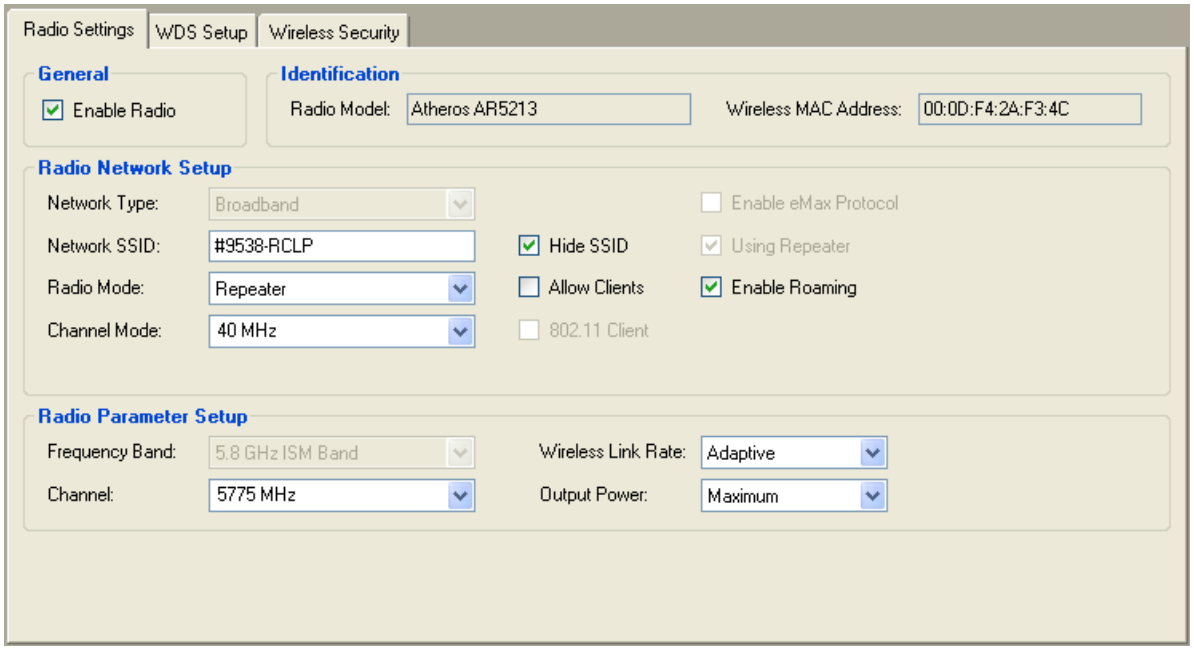
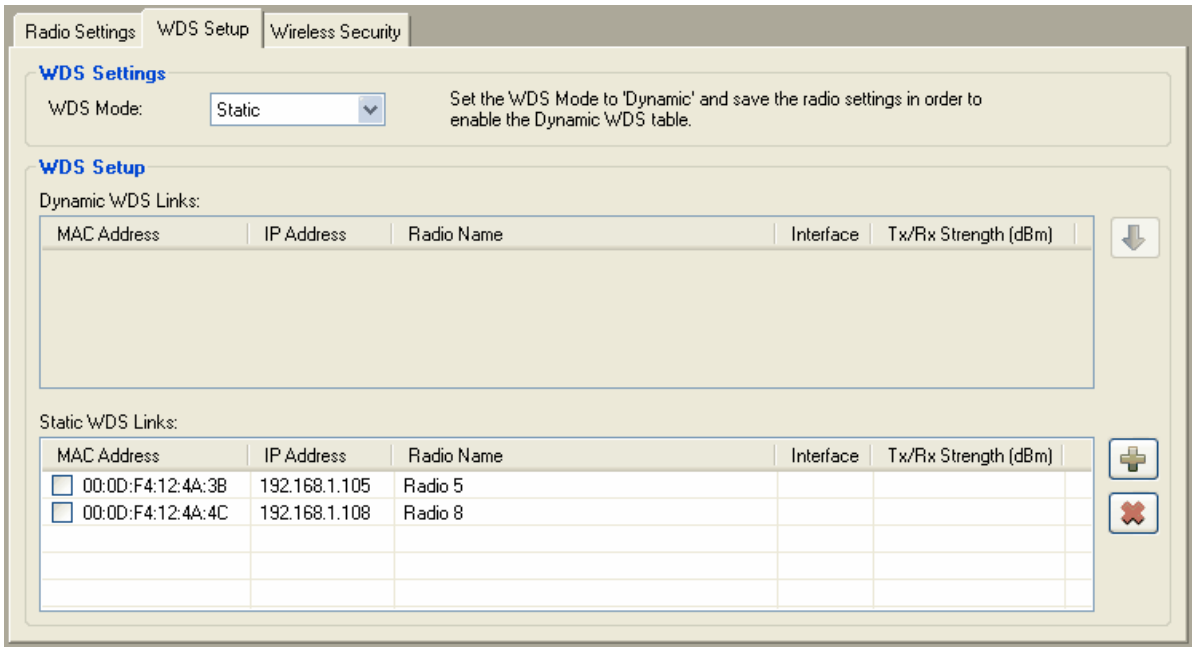
Pepeater Radio (6)

Repeater Radio 6 would be configured as follows.





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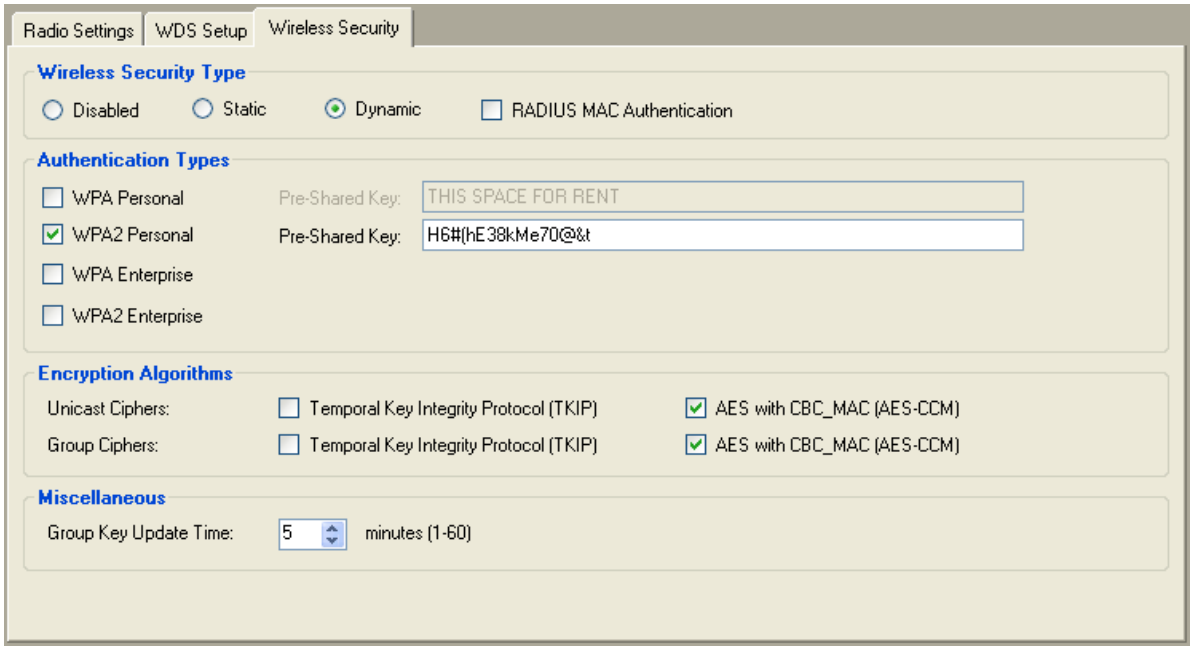

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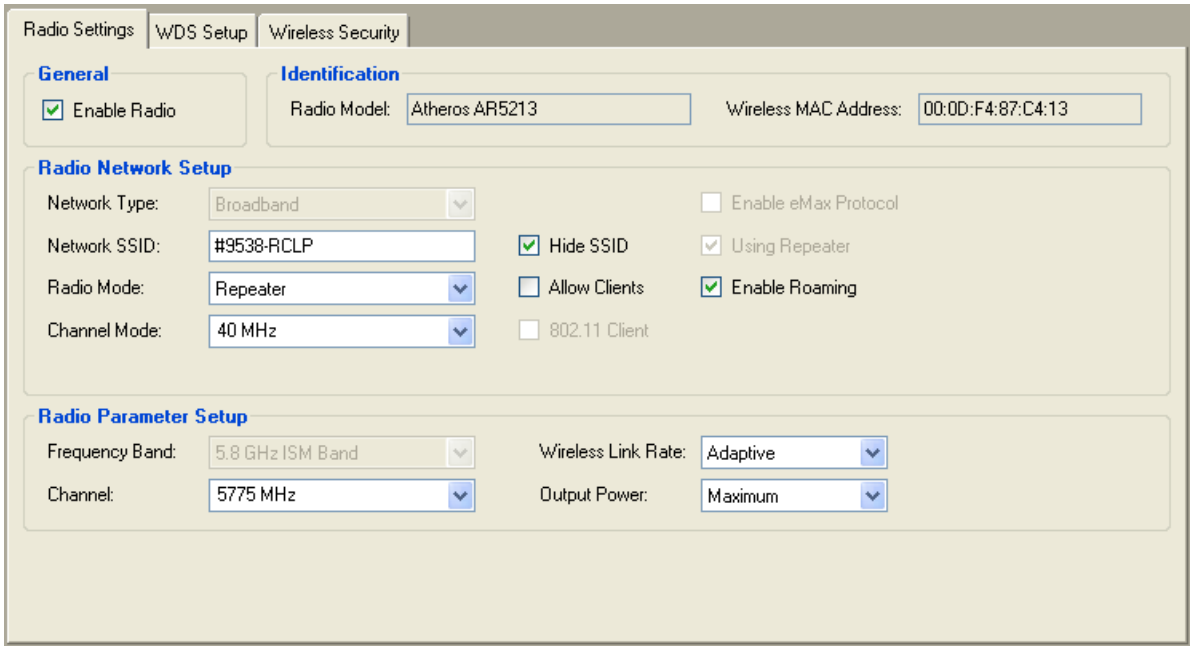
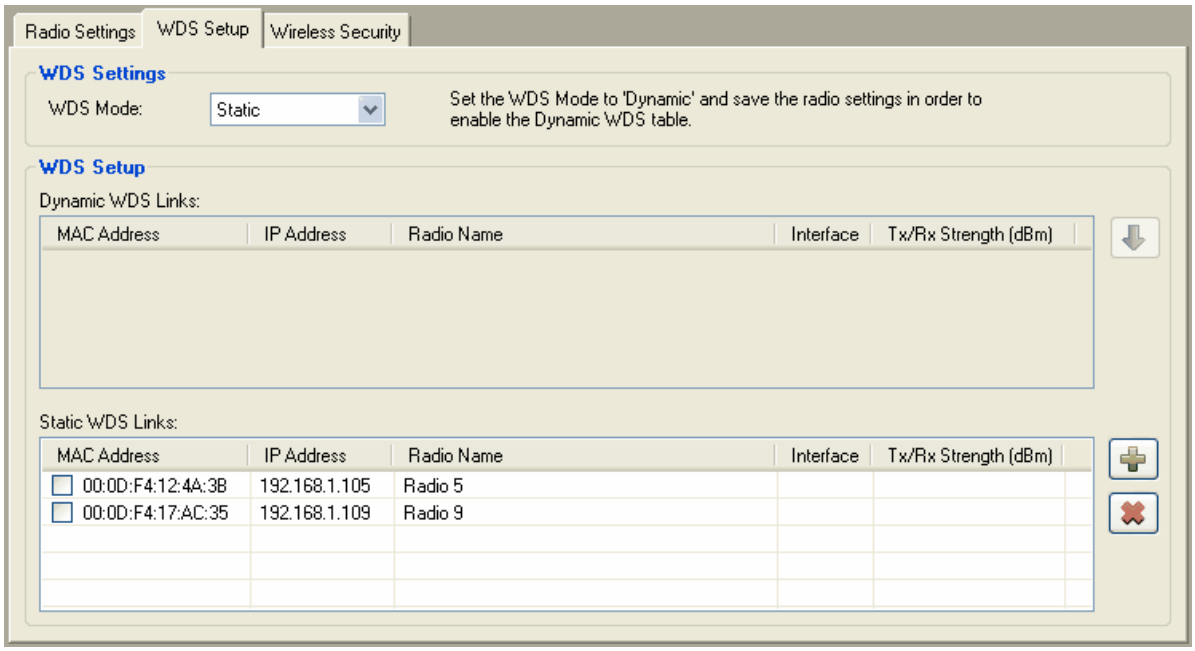
Repeater Radio (7)

Repeater Radio 7 would be configured as follows.





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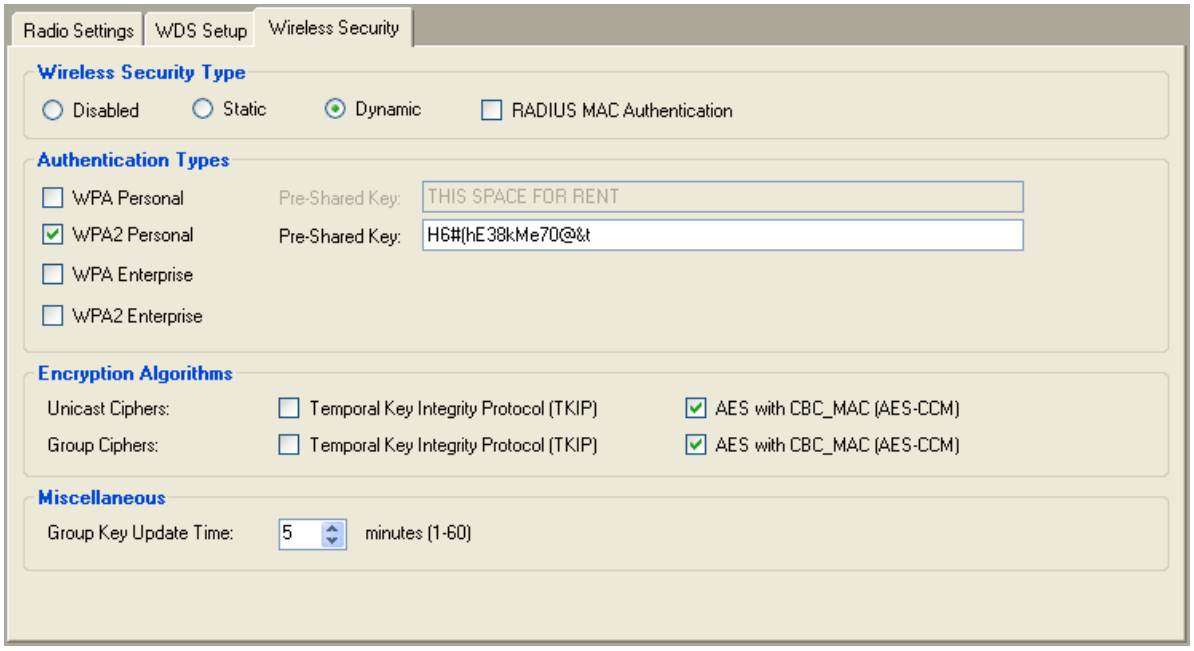

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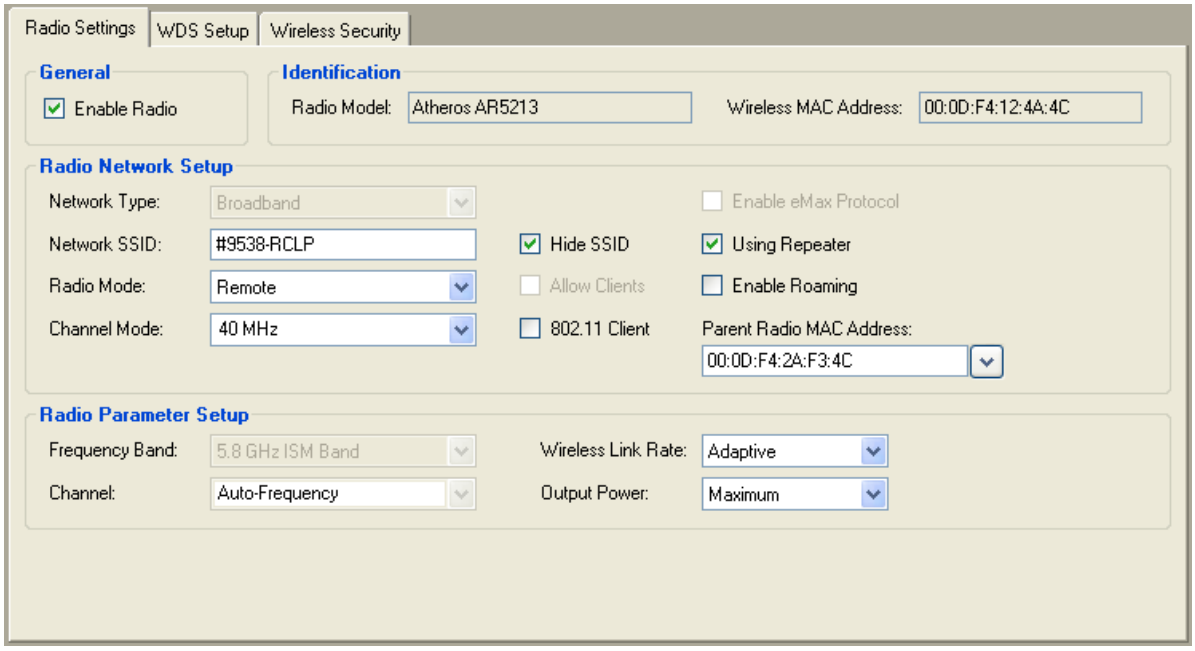
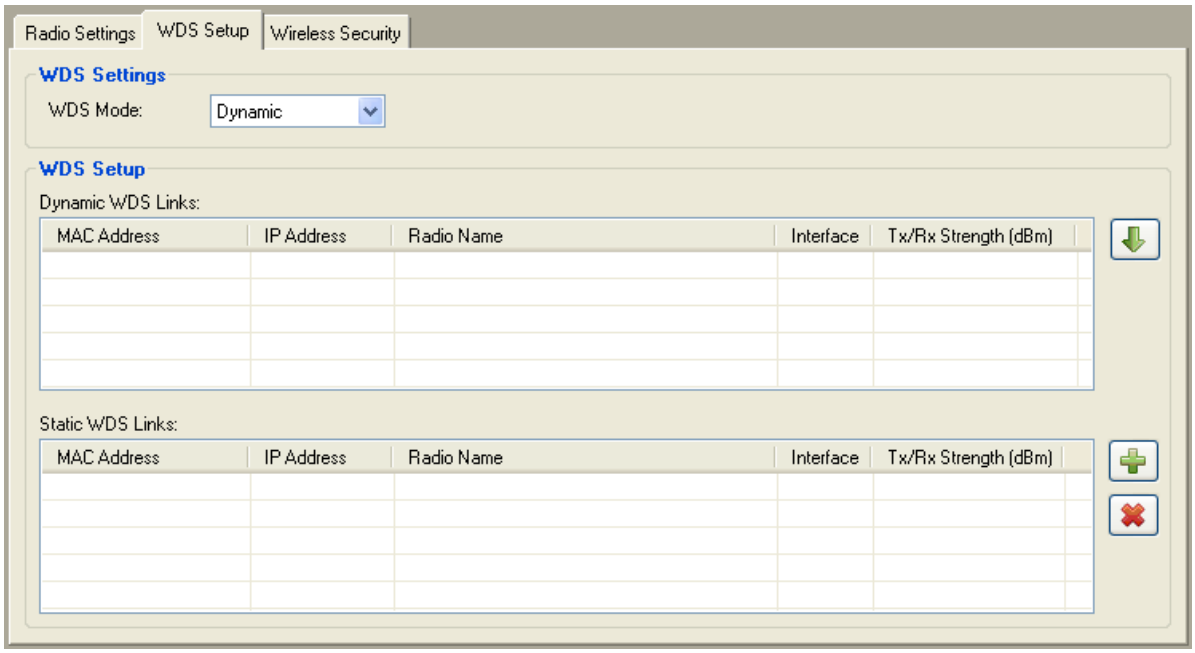
Remote Radio (8)

Remote Radio 8 would be configured as follows.





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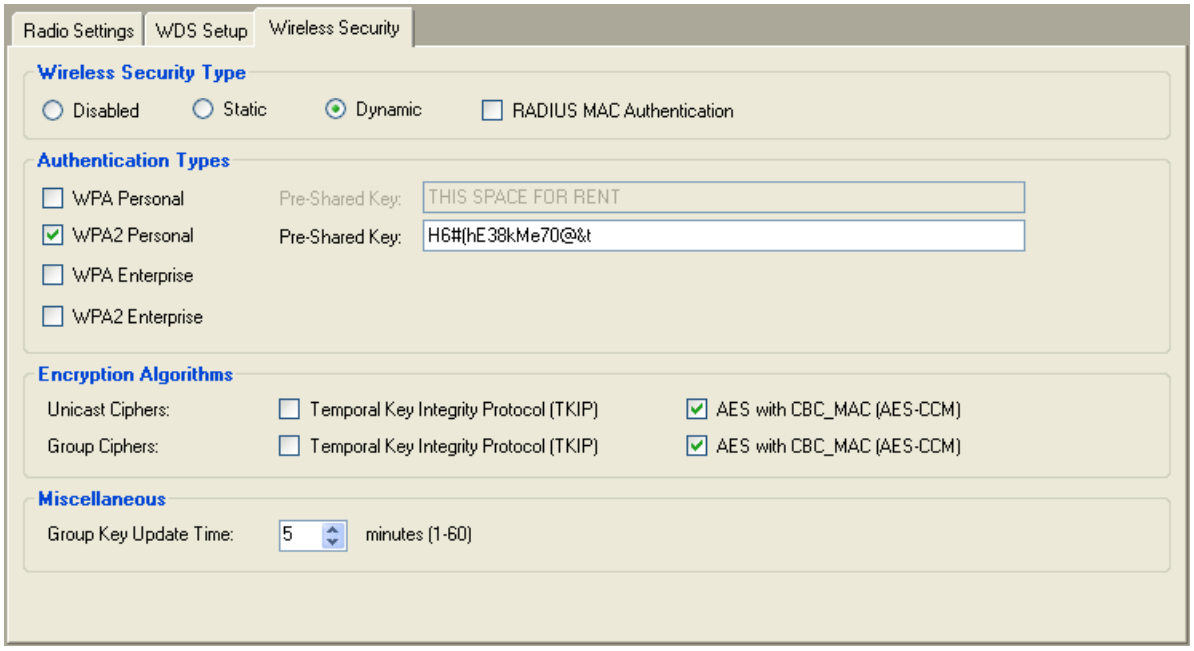

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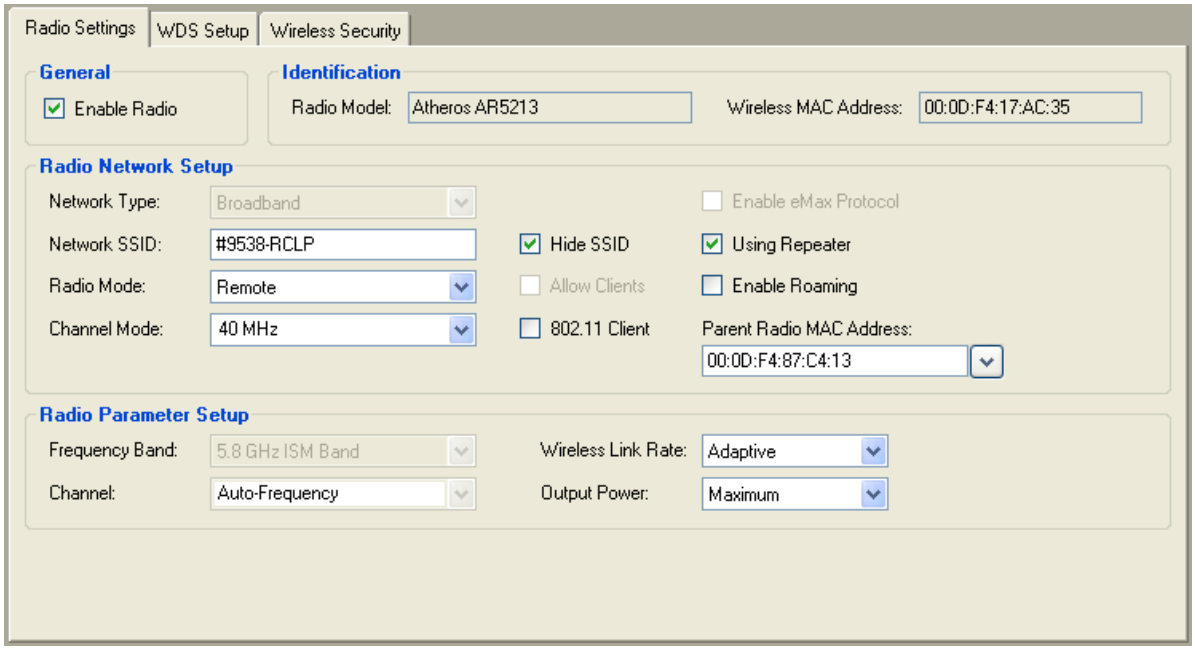
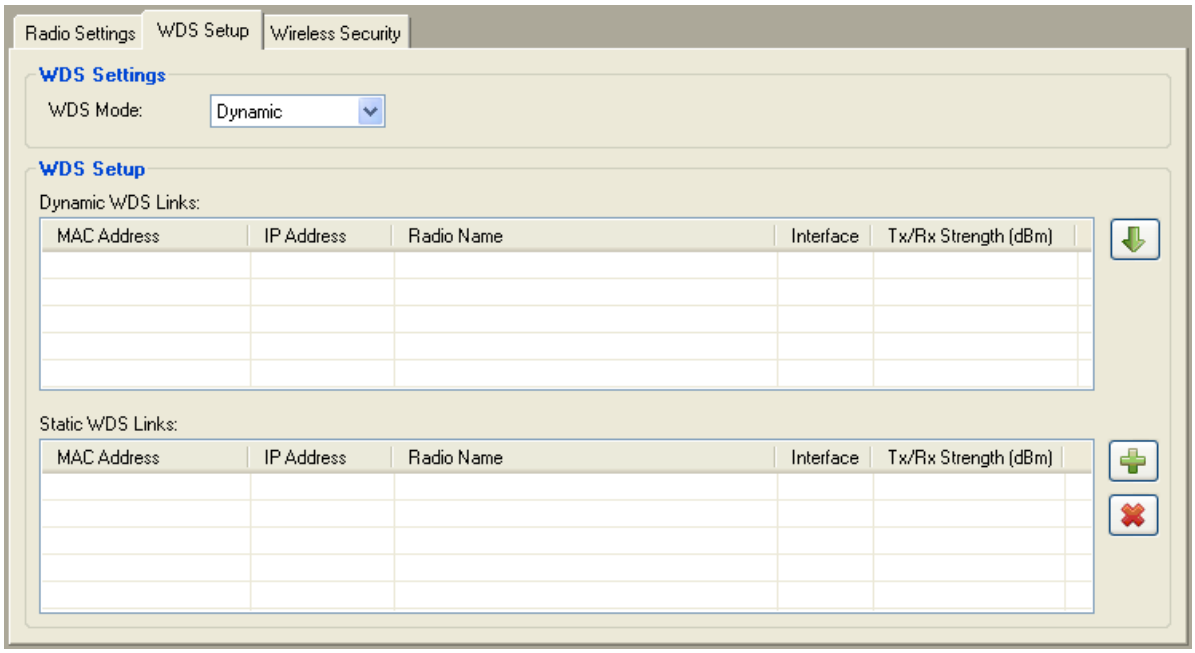
Remote Radio (9)

Remote Radio 9 would be configured as follows.





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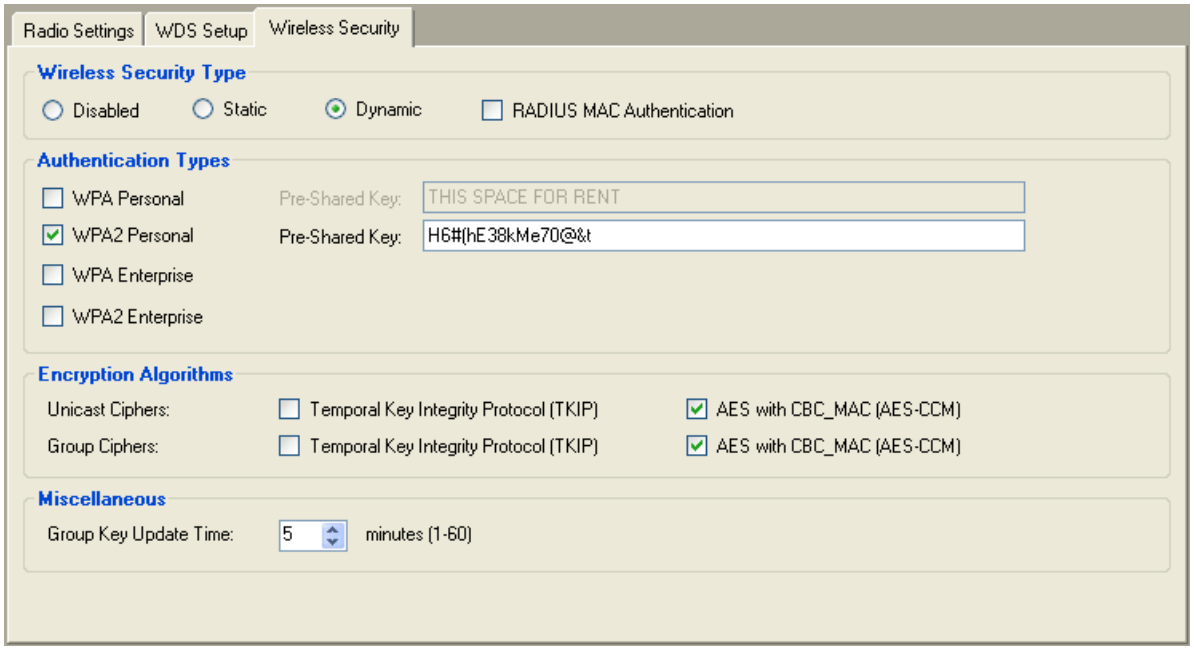

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Adding Security to an Existing Network

Securing an existing ENCOM broadband or mesh network requires that certain configuration changes be made to all of the radios in the network. When these changes are made to a radio, it will lose its wireless connection to other radios that have not yet been updated. Because of this, parts of your network will not be available while you carry out the updates.

Two strategies can be used to update the configuration of your radios: local updates, and remote updates.

Local Updates:

To perform local updates, you need physical access to the radios. This usually means driving to the site where a radio is installed, connecting directly to the radio using an Ethernet cable, and using STRATOS to update its configuration. This process would be repeated for each radio in your network.

Local updates may be fine for small networks, but could be impractical if you have a large network.

Remote Updates:

To perform remote updates, you need to connect a computer or laptop that is running STRATOS to your Traffic Management Center's (TMC) network. This should provide STRATOS with access to the entire wireless radio network. You can then update the configuration of all radios from one central location.

The rest of this section describes the procedures required to secure your radios from the TMC. Note that most of the concepts described are also applicable to local updates.

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Prerequisites (Network Diagram)

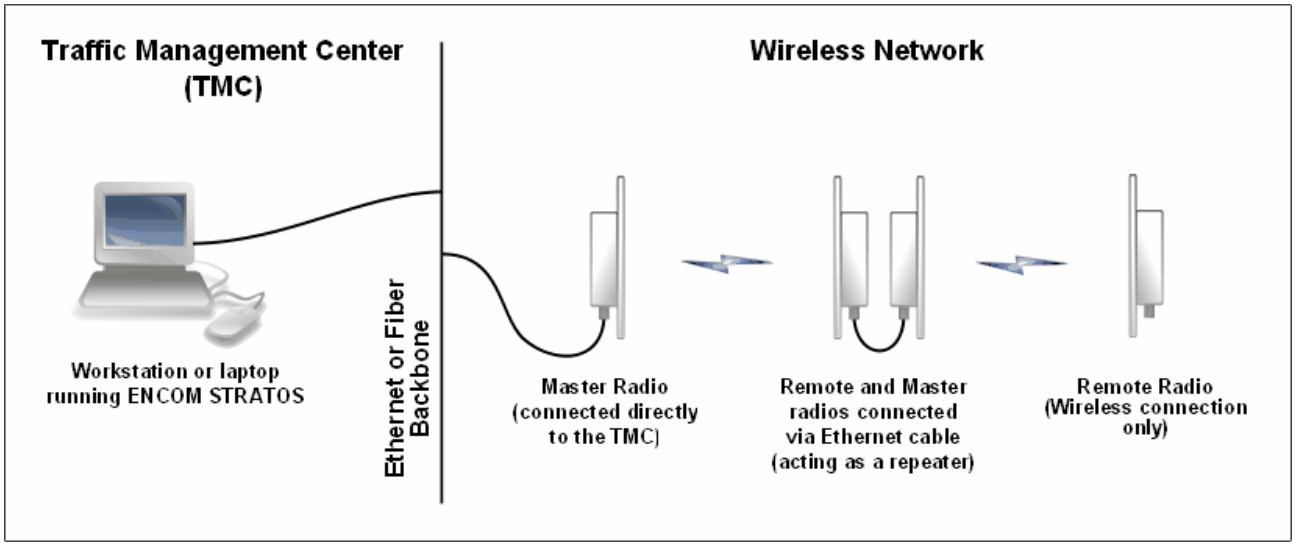
Before you start, you need to understand the layout of your wireless network. This is important to minimize network disruption while you are enabling the radios' security features.

The most useful tool for this is a network diagram that identifies:

- The radios that are directly connected to your Traffic Management Center (TMC) via an Ethernet or fiber cable.
- The wireless connections between the radios that aren't directly connected to the TMC.
- Any radios that are co-located and connected together via an Ethernet cable or switch, and that aren't directly connected to the TMC.

ENCOM strongly suggests that you create a network diagram if one is not already available. It is invaluable in determining the order in which the radios should be configured.

The following network diagram shows a simple broadband network, and displays the three types of radios described above:


Traffic Management Center (TMC)
Wireless Network
Workstation or laptop running ENCOM STRATOS
Ethernet or Fiber Backbone
Master Radio (connected directly to the TMC)
Remote and Master radios connected via Ethernet cable (acting as a repeater)
Remote Radio (Wireless connection only)

The symbols indicate the wireless links between the radios.

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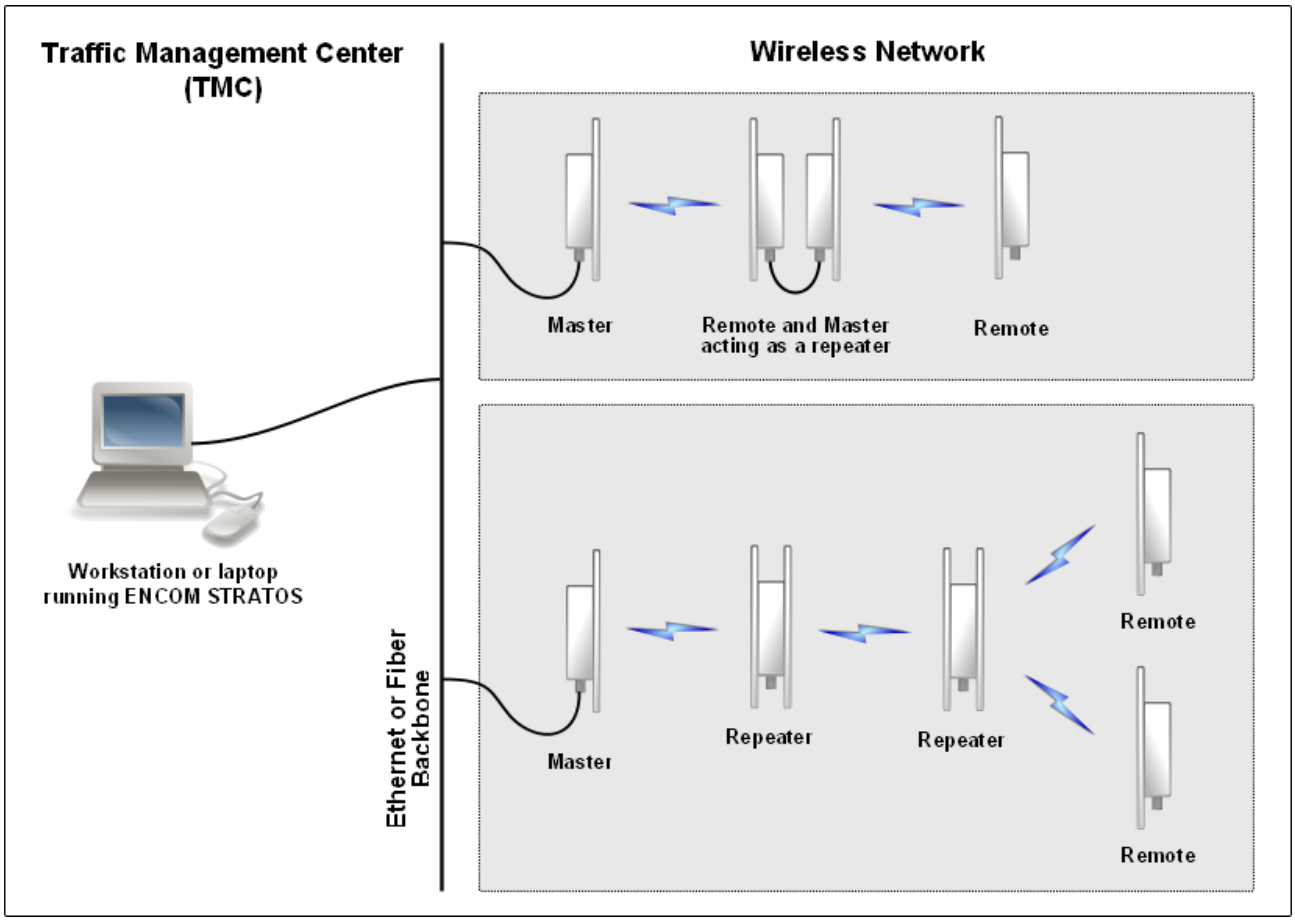
A wireless network will often be composed of several smaller stand-alone networks, each of which has one radio connected to the TMC, as shown in the following diagram:



Each stand-alone network can be treated separately. You would normally update all of the radios in one of the stand-alone networks first, and then proceed to update the other stand-alone networks in a similar fashion. This will reduce the impact of the security updates to a smaller number of radios.

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Security Update Order

As mentioned previously, when you make the configuration changes required to secure a radio, it will lose the wireless connections to any radio that has not yet been updated. In order to update all of your radios remotely, you will need to perform the updates in a specific order.

You need to change the configuration of the radios furthest from your TMC first, and then work your way back to the operations center. You will lose connection to the radios after they have been configured. The connections should be restored once you have configured the radio closest to the operations center.

If you end up with orphaned radios (radios that can no longer connect to the network, and that haven't been configured with the new security settings) you may have to configure them using a local (Ethernet) connection.

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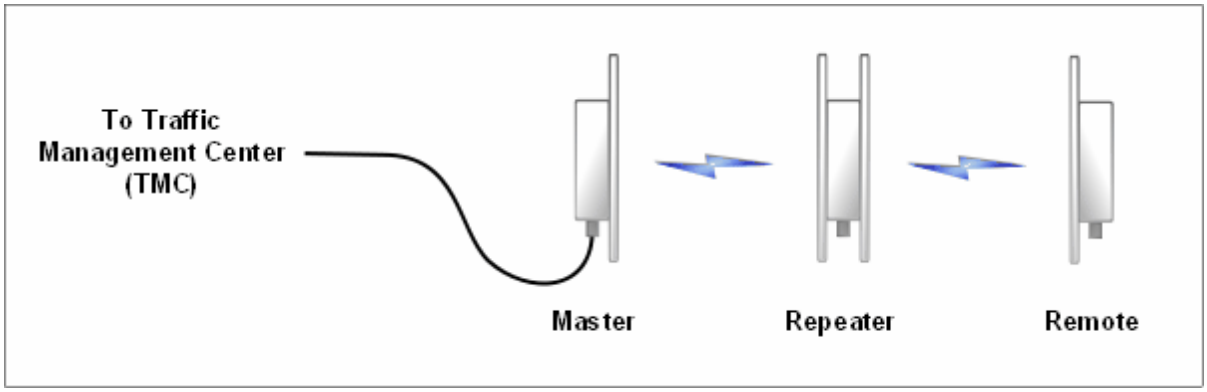
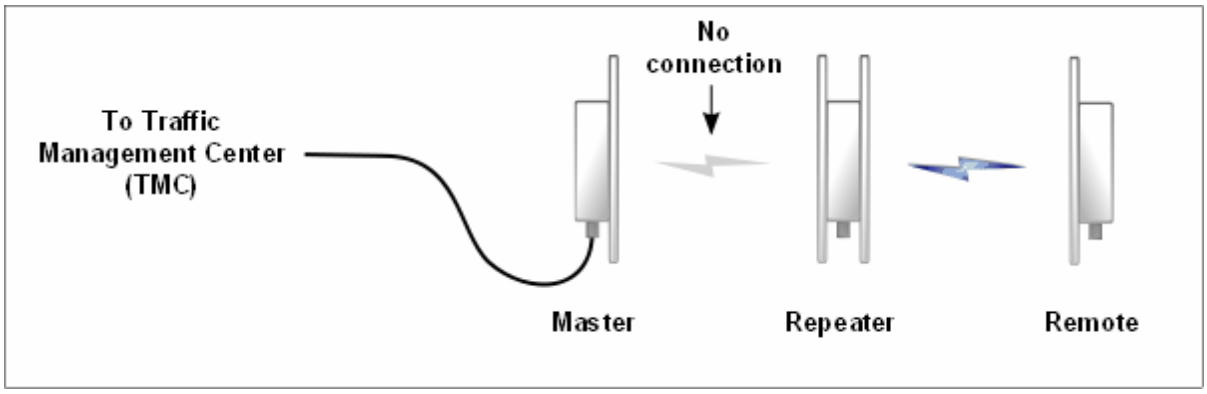
Incorrect Update Order

For example, consider the following network:



If you update the master radio first, the wireless link to the repeater will be lost, since the repeater's wireless settings are no longer compatible with the master's new settings. STRATOS will no longer be able to communicate with either the repeater or the remote, and you will not be able to update either of those radios.



To recover from this situation, you will have to restore the master radio to its original settings. This will re-establish the wireless link with the repeater, and allow STRATOS to communicate with the repeater and remote radios.

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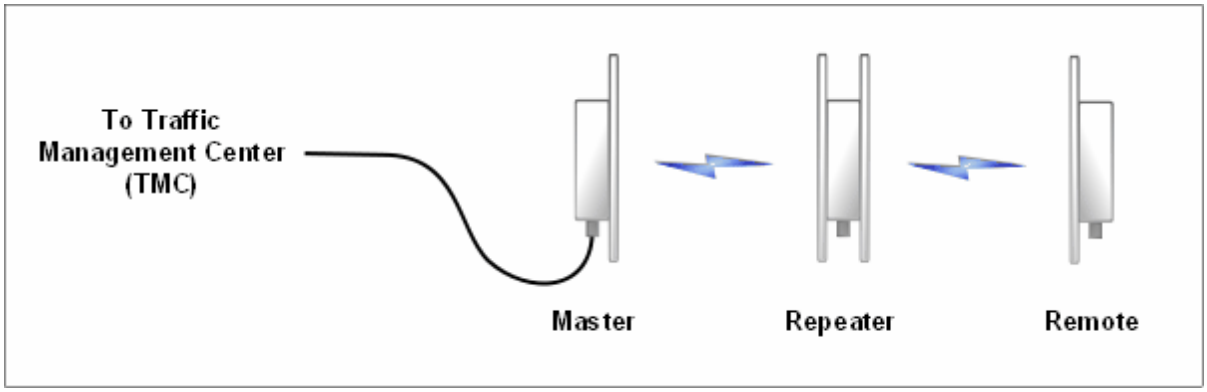
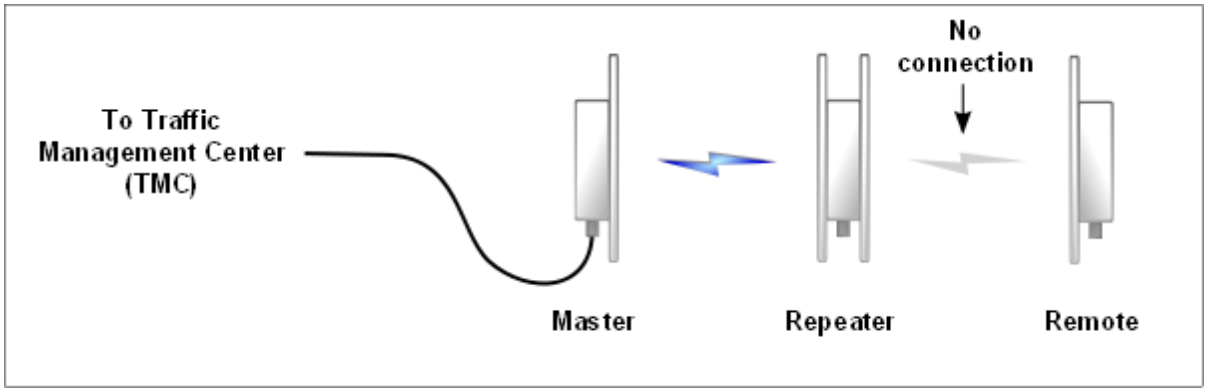
Correct Update Order

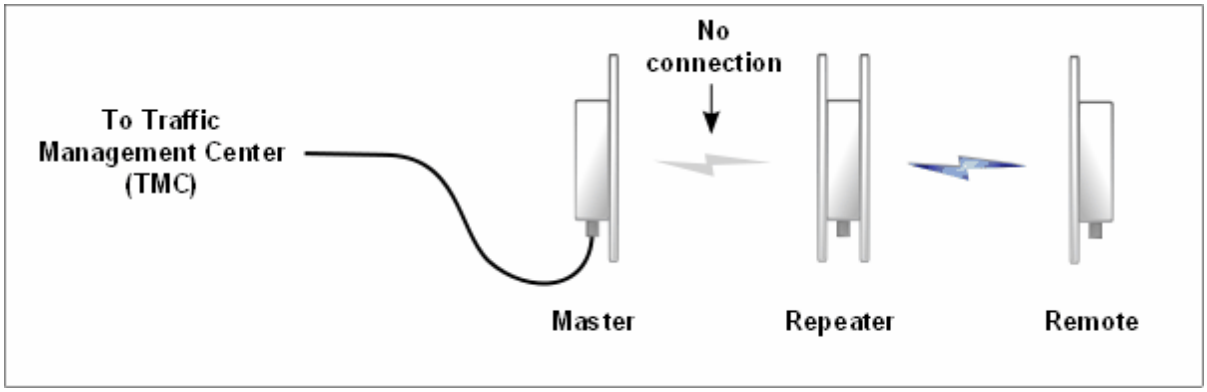
Again consider the following working network:



If you update the remote radio first, the wireless link to the repeater will be lost, since the repeater's wireless settings are no longer compatible with the remote's new settings. However, STRATOS is still able to communicate with the master and repeater.



You would then update the repeater. The wireless link with the master will be lost, since the master's wireless settings are no longer compatible with the repeater's new settings. STRATOS will still be able to communicate with the master.



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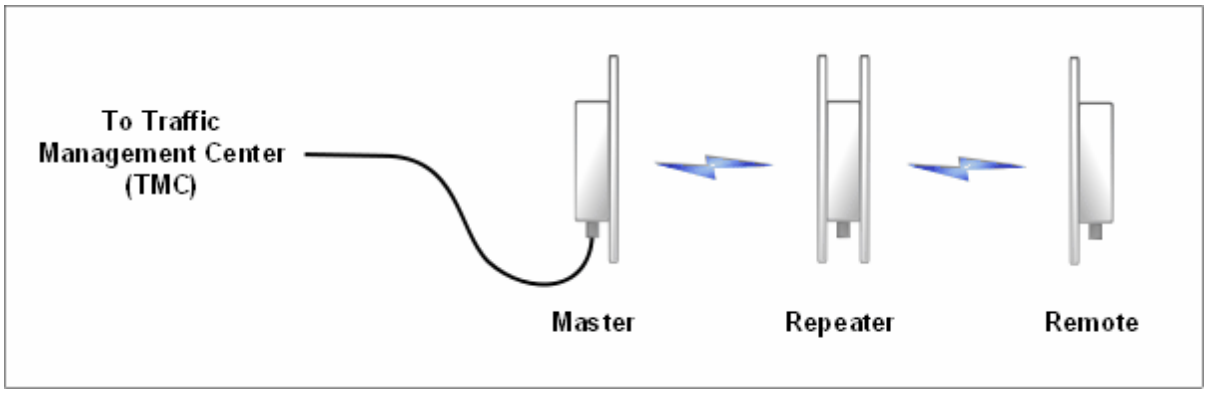
Note that the wireless link between the repeater and remote is automatically re-established, since both radios are now configured with compatible wireless settings.

Finally, you would update the master. The wireless link between the master and repeater will be re-established, and STRATOS will again be able to communicate will all of the radios.



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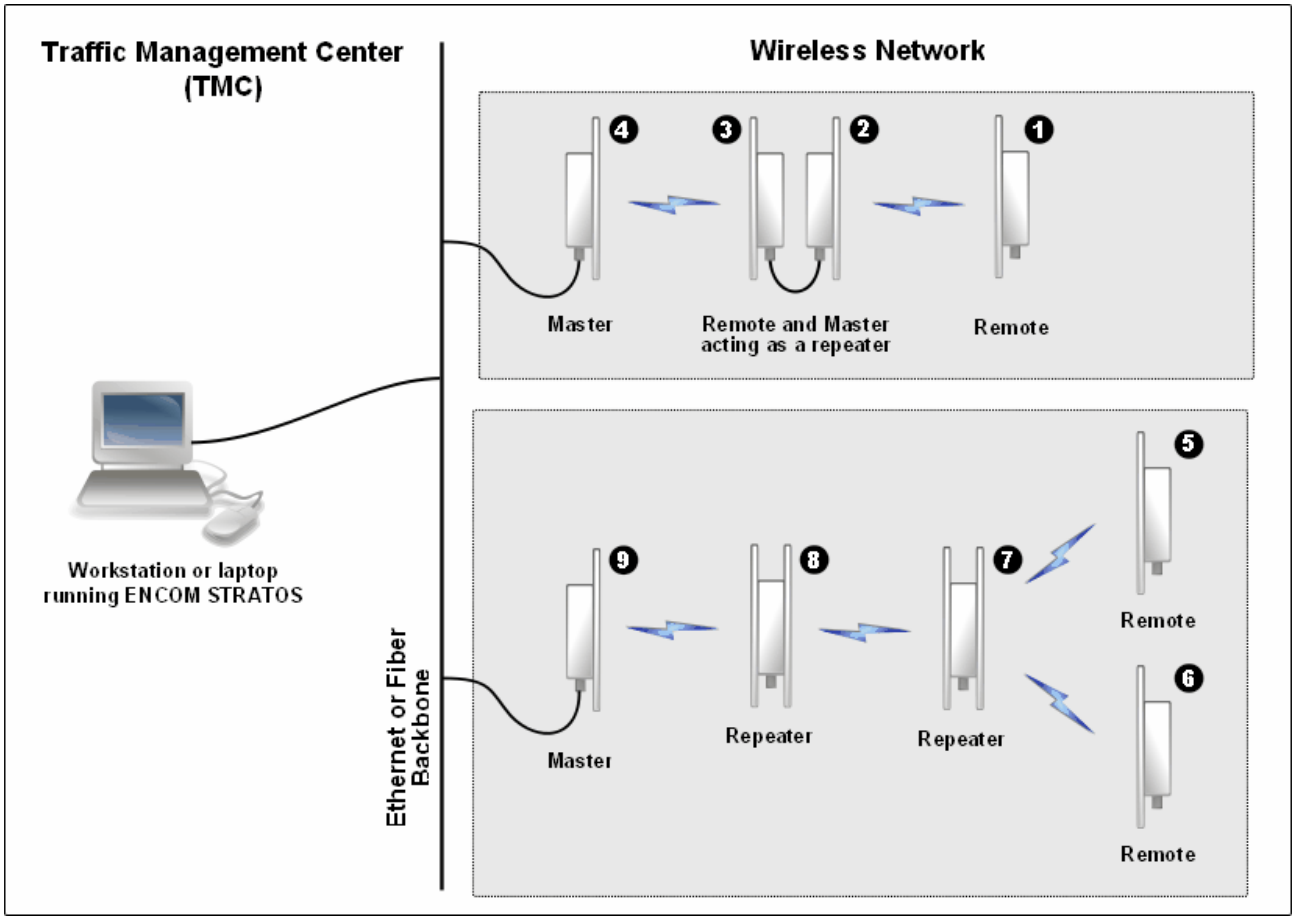
Update Order Example

The following diagram shows a simple system that consists of two stand-alone broadband networks:



The numbered bullets show the order in which the radios should updated.

Note that all of the radios in the first stand-alone network are configured first, followed by all of the radios in the second stand-alone network.

Also note that the radios farthest from the TMC are configured first, followed by the radios that are successively closer to the TMC.

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Securing the Network

This section describes the procedures required to secure your network.

The most important changes to make are to:

- Configure the radios to use the WPA2 Personal wireless encryption scheme
- Assign a secure administrative password to the radios

For a more detailed description of the security options, refer to the General Security Considerations topic.

Configuring WPA2 Wireless Encryption

Radios should be configured to use the WPA2 encryption scheme using the update order discussed in the Prerequisites topic.

You should always start with the radios farthest from the Traffic Management Center (TMC), followed by the radios that are successively closer to the TMC.

To secure the wireless links:

1. Run ENCOM STRATOS to access your radio network.
2. Select the radio you want to secure.
   a) Select **Radio -> Configure** from the main menu. (Alternatively, just double-click the radio.)
   b) In the *Configure* form that is displayed:
      i. Select the **Radio 1** tab.
      ii. Select the **Wireless Security** sub-tab.
      iii. Select the **Dynamic security** option.
      iv. Make sure that the **WPA2 Personal** option is checked.
      v. Make sure that the **WPA Personal**, **WPA Enterprise** and **WPA2 Enterprise** options remain unchecked.
      vi. Enter a strong password in the **Pre-Shared Key** field. The password should be at least 8 characters long (12 to 16 is preferable), and contain a random combination of upper and lowercase letters, numbers and punctuation characters (except for the $ and “ characters).
      vii. Make sure that the **AES with CBC_MAC (AES-CCM)** options are checked.
      viii. Make sure that the **Temporal key Integrity Protocol (TKIP)** options are unchecked.

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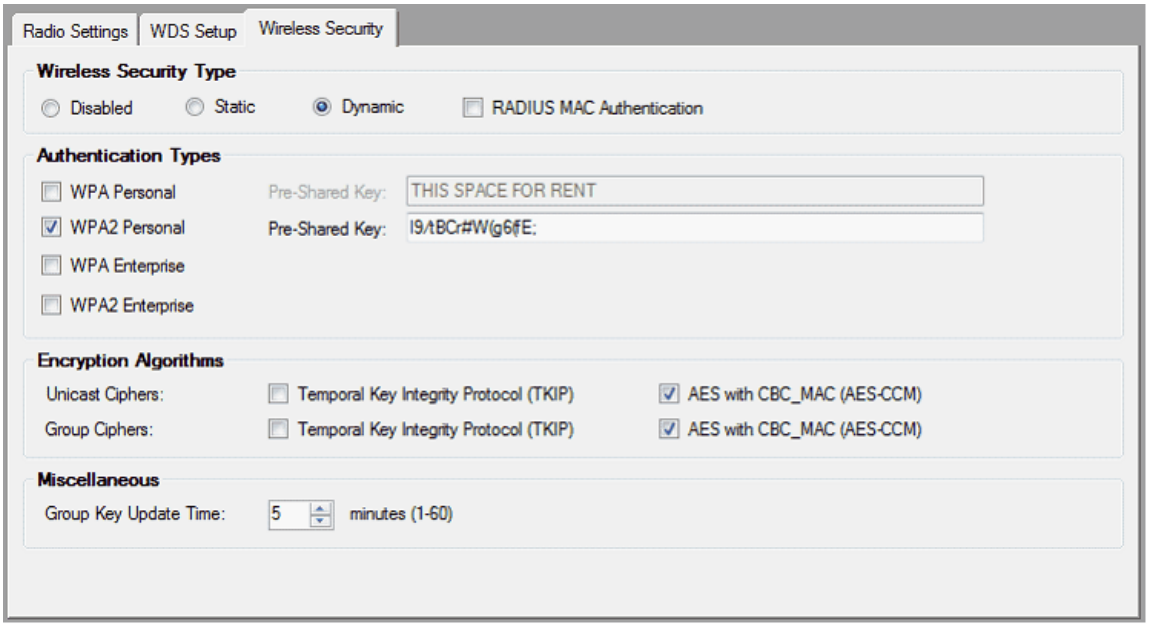
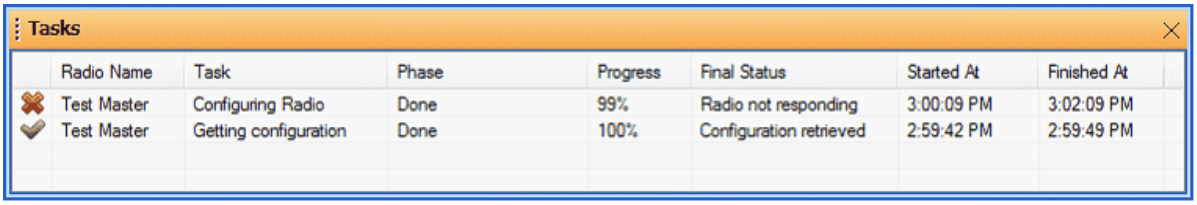
ix. The contents of your wireless security tab should look like this:



x. If you are securing a dual radio, select the **Radio 2** tab, and the **Radio Settings** sub-tab, and then repeat steps iii-ix.

xi. Press the **OK** button to save the new security settings to the radio.

c) If the radio you are updating is not directly connected to the TMC, STRATOS will no longer be able to communicate with it. The radio will eventually go off-line, and the configuration task will show up as having failed:



This is normal. This radio will become available again when the radio that is connected to the TMC is updated.

3. Repeat step 2 for the remaining radios in your network.

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Assigning a Secure Password

Changing a radio's password has no effect on the wireless links. You can therefore change the radio passwords in any order, and at any time.

To secure access to the radios:

1. Run ENCOM STRATOS to access your network.
2. Select the radio you want to secure.
   a) Select **Radio -> Change Password** from the main menu.
   b) In the *Change Password* form that is displayed:
      i. Enter a strong password in the **New Password** field. The password should be at least 8 characters long, and contain a random combination of upper and lowercase letters, numbers and punctuation characters (except for the $, " and ? characters).
      ii. Enter the same password in the **Confirm Password** field.
      iii. Press the **OK** button to save the new password to the radio.
3. Repeat step 2 for the remaining radios in your network. To more easily manage your network, you should use the same administrative password for all of your radios.
4. The next time you run STRATOS, you will have to log in using the new administrative password.

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